DAFTAR PUSTAKA

Apandi , T. & Bachri, S., (1997). *Peta Geologi Lembar Kotamobagu.* 2 ed. Bandung: Pusat Penelitian dan Pengembangan Geologi.

Arribas, A. (1995). Characteristics of High-Sulfidation Ephitermal Deposits, And Their Relation To Magmatic Fluid. *Mineralogical Association of Canada Short Course Series*, Vol. 23. p. 157-166.

Bakkar, U. Z., Kasim, M., Akase, N. & Rompo, A. I., (2020). Karakteristik Alterasi dan Mineralisasi Hidrotermal Daerah Huluwa, Gorontalo, Indonesia. *Jambura Geoscince Review,* Volume 2, pp. 1-15.

Bateman, A. M., (1981). *Economic Mineral Deposit.* 3 rd ed. New York: John Wiley and Sons.

Binsar, M. T. A., Aribowo, Y. & Widiarso, D. A., (2014). *Geologi, Alterasi Hidrotermal dan Mineralisasi Daerah Ciurug dan Sekitarnya, Kecamatan Nanggung, Kabupaten Bogor, Provinsi Jawa Barat,* Semarang: Universitas Diponegoro.

Cahya, A. D., (2017). *Geologi dan Studi Paragenesa Mineralisasi Daerah Bakan dan Sekitarnya, Kecamatan Lolayan, Kabupaten Bolaang Mongondow, Provinsi Sulawesi Utara.* Yogyakarta: UPN "Veteran" Yogyakarta.

Carlile, J.C., Digdowirogo S., and Darius K. (1990). Geological Setting, Characteristics and Regional Exploration for Gold in the Volcanic Arcs of North Sulawesi, Indonesia, *Journal of Geochemical Exploration*, 35, p 105-140.

Corbett, G. J. & Leach, T. M., (1998). *Southwest Pacific Rim Gold-copper Systems : Structure, Alteration, and Mineralization. Society of Economic Geologist Special Publication* No. 6, 236 p.

Corbett, G. (2005). Ephitermal Au-Ag Deposit Types-Implication for Exploration. AIG Journal-Applied Geoscientific Practice and Research in Australia: Paper 2002-01

Hamilton, W. B., (1979). Tectonics of the Indonesian region (Vol. 1078). US Government Printing Office.

Hardjana, I., (2012). The Discovery, Geology and Exploration of the High Sulphidation Au-Mineralization System in The Bakan District, North Sulawesi.

ist, J. W., (1987). Mineralization Associated with Volcanic-Related ydrothermal Systems in the Circum Pacific Basin. *4th Circum-Pacific nergy and Mineral Resources Conference,* pp. 513-515.

Hedenquist, J. W., Arribas, A. J. & Gonzalez-Urien, E., (2000). Exploration for Epithermal Gold Deposit:. *Review in Economic Geology,* Volume 13, pp. 245-277.

Hedenquist, J. W., Izawa , E., Arribas, A. & White, N. C., (1996). Epithermal Gold Deposits: Styles, Characteristics, and Exploration. *Society of Resource Geology Ressource Geology Special Publication.*

Idrus, A. & Prihatmoko, S. (2022) Endapan Emas Epitermal: Geologi, Karakteristik dan Metode Eksplorasi. Yogyakarta: Teknosain

Kavalieris, I., Van Leeuwen, T.M., Wilson, M. (1992). Geological Setting and Styles of Mineralisation, North Arm of Sulawesi, Indonesia. J. SE Asian Earth Sci. 7(2/3), 113- 130.

Pirajno, F., (1992). *Hydrothermal Mineral Deposits, Principles and Fundamental Concept for the Exploration Geologist.* Australia: Springer.

Pirajno, F., (2009). *Hydrothermal Processes and Mineral System.* Australia: Geological Survey of Western Australia.

Proyogi, E. T. & Suganda , B. R., (2014). *Geologi Daerah Tajur dan Sekitarnya, Kecamatan Citereup, Kabupaten Bogor Propinsi Jawa Barat,* Sumedang: Universitas Padjadjaran.

Setiabudi, R. H. A. M., (2012). *Karakteristik Mineral Prinsip dan Aplikasinya dalam Penelitian Kimia.* Bandung: UPI PRESS.

Setiawan & Jati, (2020). Mineralisasi Endapan Epitermal dan Sistem Wreench Fault. In: s.l.:s.n.

Sillitoe, R. H. (1999). Style of Hohg-Sulphidation Gold , Silver, and Copper Mineralization in the Porphyry and Ephitermal Environment. Proceeding of PacRim '99, Bali, Indonesia, 10-13 October, p.29-44.

Sillitoe, R. H. & Hedenquist, J. W., (2003). Linkages between volcanotectonic setting, ore-fluid compositions and epithermal precious metal deposits. *Society of Economi Geologist,* pp. 315-343.

Silver, E. A., McCaffrey, R. & Sith, R. B., (1983). Back arc thrusting in the eastern Sunda arc, Indonesia: A consequence of arc-continent collision. *Journal of Geophysical Research: Solid Earth,* Volume 88, pp. 9407-9418.

Simmons, S. F., White, N. C. & John, D. A., (2005). Geological Characteristic of Epithermal Precious and Base Metal Deposits. *Society of Economic Geologist,* pp. 485-522.

R., (1975). *The Structur of Sulawesi in The Light of Plate Tectonics* *ssociation of Indonesia Geologist*.

Sukandarrumidi, (2009), *Geologi Mineral Logam*, Gadjah Mada University Press,Yogyakarta.

Thompson, A.J.B. dan Thompson, J.F.H., (1996), *Atlas of Alteration A Field And Petrographic Guide To Hydrothermal Alteration Minerals*, Mineral Deposots Division. Canada.

Van Bemmelen, R.W., (1970). *The Geology of Indonesia*. 2nd Edition, Martinus Nijhoff, The Hague.

Van Zuidam, R. A. (1983), *Guide to Geomorphology Aerial Photographic Interpretation and Mapping*, ITC, Enschede, The Netherlands.

Van Leeuwen, T. M. & Muhardjo, (2005). Stratigraphy and Tectonic Setting of the Cretaceous and Palaeogene Volcanic–Sedimentary successions in Northwest Sulawesi, Indonesia: Implications for the Cenozoic evolution of Western and Northern Sulawesi. *Journal of Asian Earth Sciences,* Volume 25, pp. 481-511.

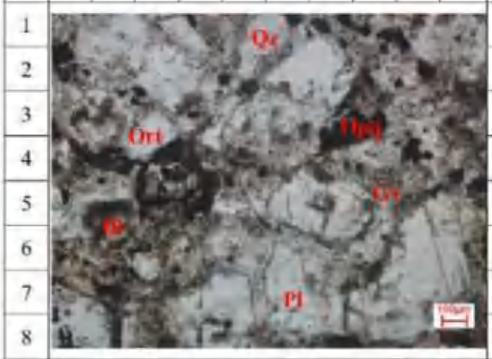
White, N. C. & Hedenquist, J. W., (1995). Epithermal Environments and Styles of Mineralization: Variations and their Causes, and Guidelines for Exploration. *Journal of Geochemical Exploration,* Volume 36, pp. 445-474.

White, N.C., Leake, M.J., McCaughey, S.N. and Parris, B.W., (1995). Epithermal gold deposits of the southwest Pacific. *Journal of Geochemical Exploration*, 54, 87-136.

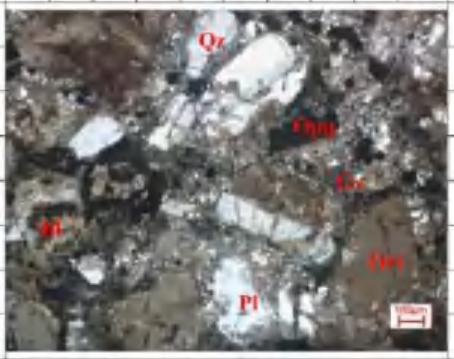
Lampiran 1 Analisis petrografi

No. Urut : 1
No. Sampel : LP 1 (1)

Foto



//-NIKOL



X-NIKOL

Lensa Okuler : 10x Lensa Objektif : 5x Perbesaran Total : 50x

Tipe Batuan : Batuan Beku
Tipe Struktur : Massive

Deskripsi Mikroskopis :
Kenampakan sayatan batuan pada warna absorbsi *colorless*, nikol silang abu-abu kehitaman, granularitas porfiritik, kristanilitas hipokristalin, relasi inequigranular, bentuk mineral euhedral-subhedral, tekstur intergrowth.

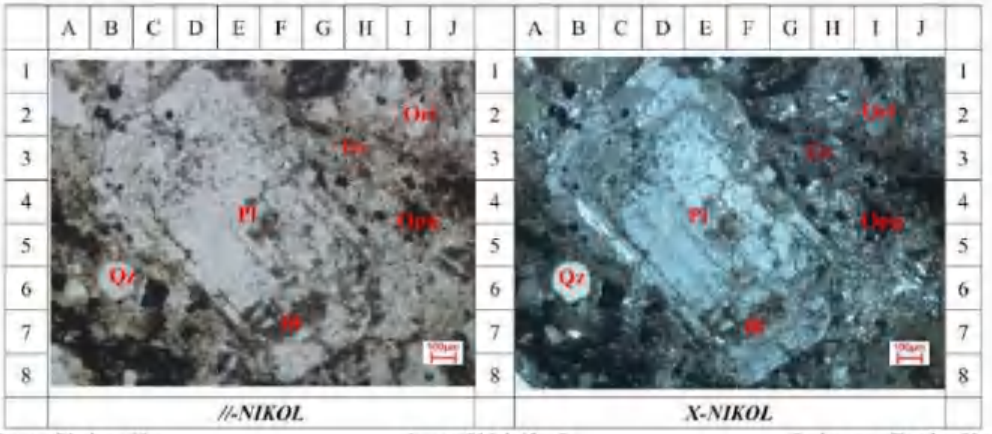
Deskripsi Mineralogi

Komposisi Mineral	Jumlah (%)	Keterangan Optik Mineral
Plagioklas (Pl)	35%	Warna absorbsi *colorless*, belahan satu arah, intensitas kuat, relief sedang, indeks bias $n_{min} > n_{cb}$, pleokroisme lemah, pecahan tidak ada, bentuk mineral euhedral-subhedral, warna interferensi abu kehitaman, kembaran albit, sudut gelapan 21°, jenis gelapan miring, dengan ukuran mineral 0,8-1,1 mm. Nama plagioklas adalah **Andesine.**
Kuarsa (Qz)	5%	Warna absorbsi *colorless*, belahan tidak ada, intensitas tinggi, relief rendah, indeks bias $n_{min} > n_{cb}$, pleokroisme lemah, pecahan tidak ada, bentuk subhedral-anhedral, warna interferensi putih, kembaran tidak ada, sudut gelapan 3°, jenis gelapan bergelombang, dengan ukuran mineral 0,5-1 mm.
Ortoklas (Ort)	25%	Warna absorbsi *colorless*, belahan tidak ada, intensitas tinggi, relief rendah, indeks bias $n_{min} > n_{cb}$, pleokroisme lemah, pecahan tidak ada, bentuk euhedral-subhedral, warna interferensi abu-abu kehitaman, kembaran carlsbad, sudut gelapan 15°, jenis gelapan miring, dengan ukuran mineral 0,8-1,3 mm.
Illite (Ill)	10%	Warna absorbsi *colorless*, belahan tidak ada, intensitas tinggi, relief rendah, indeks bias $n_{min} > n_{cb}$, pleokroisme lemah, pecahan tidak ada, bentuk subhedral-anhedral, warna interferensi kuning kecoklatan, kembaran tidak ada, sudut gelapan 24°, jenis gelapan miring, dengan ukuran mineral 0,1-0,3 mm.
Mineral Opaq (Opq)	10%	Warna absorbsi hitam, bentuk subhedral-anhedral, warna interferensi hitam, dengan ukuran mineral 0,3-0,5 mm.
Glass Vulkanik (Gv)	15%	Warna absorbsi *colorless*, warna interferensi abu kehitaman.

Nama Batuan : Batuan Teralterasi

No. Urut : 1
No. Sampel : LP 1 (2)

Foto



Lensa Okuler : 10x Lensa Objektif : 5x Perbesaran Total : 50x

Tipe Batuan : Batuan Beku
Tipe Struktur : Massive

Deskripsi Mikroskopis :
Kenampakan sayatan batuan pada warna absorbsi *colorless*, nikol silang abu-abu kehitaman, granularitas porfiritik, kristanilitas hipokristalin, relasi inequigranular, bentuk mineral euhedral-subhedral, tekstur intergrowth.

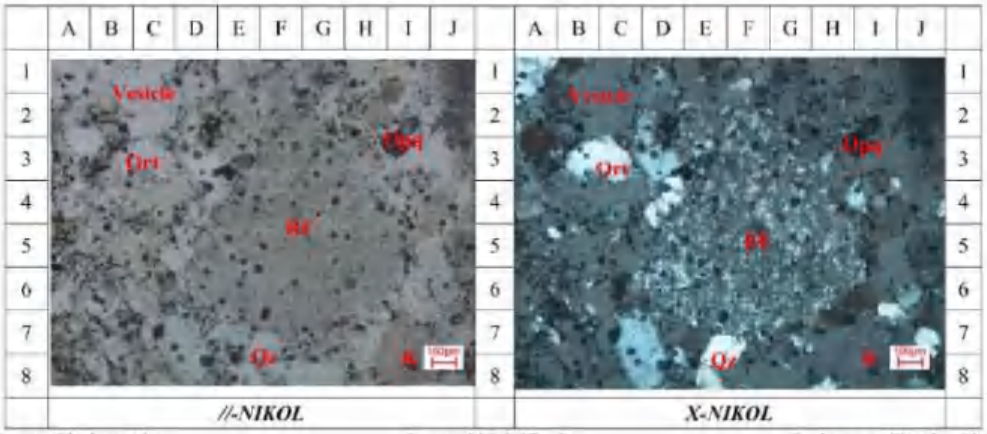
Deskripsi Mineralogi

Komposisi Mineral	Jumlah (%)	Keterangan Optik Mineral
Plagioklas (Pl)	35%	Warna absorbsi *colorless*, belahan tidak ada, intensitas tinggi, relief rendah, indeks bias $n_{min} > n_{cb}$, pleokroisme lemah, pecahan tidak ada, bentuk euhedral-subhedral, warna interferensi abu-abu kehitaman, kembaran albit, sudut gelapan 41°, jenis gelapan miring, dengan ukuran mineral 1,56 mm. Dijumpai tekstur zoning pada mineral ini.
Kuarsa (Qz)	5%	Warna absorbsi *colorless*, belahan tidak ada, intensitas tinggi, relief rendah, indeks bias $n_{min} > n_{cb}$, pleokroisme lemah, pecahan tidak ada, bentuk subhedral-anhedral, warna interferensi putih, kembaran tidak ada, sudut gelapan 2°, jenis gelapan bergelombang, dengan ukuran mineral 0,15-0,8 mm.
Ortoklas (Ort)	25%	Warna absorbsi *colorless*, belahan tidak ada, intensitas tinggi, relief rendah, indeks bias $n_{min} > n_{cb}$, pleokroisme lemah, pecahan tidak ada, bentuk subhedral-anhedral, warna interferensi abu-abu kehitaman, kembaran carlsbad, sudut gelapan 23°, jenis gelapan miring, dengan ukuran mineral 0,1-0,7 mm.
Illite (Ill)	5%	Warna absorbsi *colorless*, belahan tidak ada, intensitas tinggi, relief rendah, indeks bias $n_{min} > n_{cb}$, pleokroisme lemah, pecahan tidak ada, bentuk subhedral-anhedral, warna interferensi kuning kecoklatan, kembaran tidak ada, sudut gelapan 27°, jenis gelapan miring, dengan ukuran mineral 0,1-0,2 mm.
Mineral Opaq (Opq)	15%	Warna absorbsi hitam, bentuk subhedral-anhedral, warna interferensi hitam, dengan ukuran mineral 0,05-0,6 mm.
Glass Vulkanik (Gv)	15%	Warna absorbsi *colorless*, warna interferensi abu kehitaman.

Nama Batuan : Batuan Teralterasi

No. Urut : 2
No. Sampel : LP 11 (1)

Foto



Lensa Okuler : 10x Lensa Objektif : 5x Perbesaran Total : 50x

Tipe Batuan : Batuan Beku
Tipe Struktur : Vesicle

Deskripsi Mikroskopis :
Kenampakan sayatan batuan pada warna absorbsi *colorless*, nikol silang abu-abu kehitaman, granularitas porfiritik, kristanilitas hipokristalin, relasi inequigranular, bentuk mineral euhedral-subhedral, tekstur intergrowth.

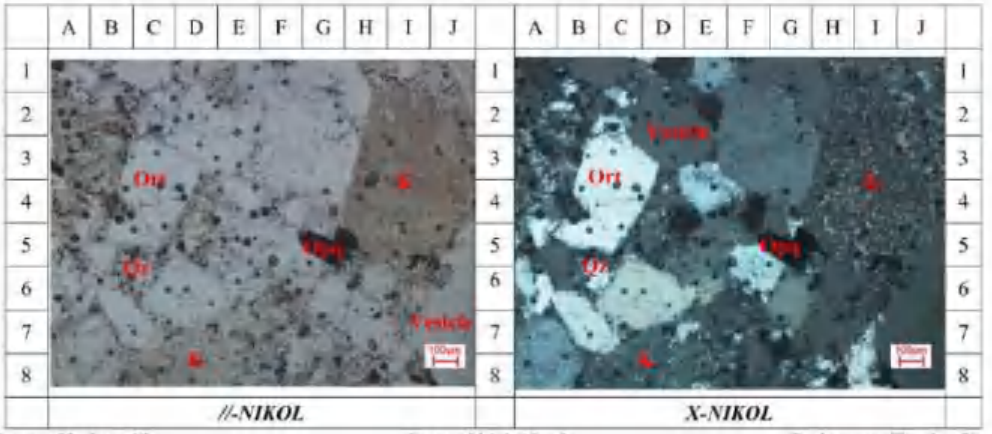
Deskripsi Mineralogi

Komposisi Mineral		Jumlah (%)	Keterangan Optik Mineral
Rock Fragmen (RF)	Kuarsa	45%	Warna absorbsi *colorless*, belahan tidak ada, intensitas tinggi, relief rendah, indeks bias $n_{min} > n_{cb}$, pleokroisme lemah, pecahan tidak ada, bentuk subhedral-anhedral, warna interferensi putih, kembaran tidak ada, sudut gelapan 3°, jenis gelapan bergelombang.
	Biotit		Warna absorbsi coklat, belahan tidak ada, intensitas tinggi, relief rendah, indeks bias $n_{min} > n_{cb}$, pleokroisme lemah, pecahan tidak ada, bentuk subhedral-anhedral, warna interferensi coklat, kembaran tidak ada, sudut gelapan 15°, jenis gelapan miring.
Kaolin (K)		5%	Warna absorbsi *colorless*, belahan tidak ada, intensitas tinggi, relief rendah, indeks bias $n_{min} > n_{cb}$, pleokroisme lemah, pecahan tidak ada, bentuk subhedral-anhedral, warna interferensi, abu kehitaman, kembaran tidak ada, sudut gelapan 17°, jenis gelapan miring, dengan ukuran mineral 0,8-1,1 mm.
Kuarsa (Qz)		10%	Warna absorbsi *colorless*, belahan tidak ada, intensitas tinggi, relief rendah, indeks bias $n_{min} > n_{cb}$, pleokroisme lemah, pecahan tidak ada, bentuk subhedral-anhedral, warna interferensi putih, kembaran tidak ada, sudut gelapan 3°, jenis gelapan bergelombang, dengan ukuran mineral 0,1-0,5 mm.
Ortoklas (Ort)		1%	Warna absorbsi *colorless*, belahan tidak ada, intensitas tinggi, relief rendah, indeks bias $n_{min} > n_{cb}$, pleokroisme lemah, pecahan tidak ada, bentuk subhedral-anhedral, warna interferensi abu-abu kehitaman, kembaran carlsbad, sudut gelapan 18°, jenis gelapan miring, dengan ukuran mineral 0,1-0,6 mm.
Mineral Opaq (Opq)		25%	Warna absorbsi hitam, bentuk subhedral-anhedral, warna interferensi hitam, dengan ukuran mineral 0,1-0,2 mm.

Nama Batuan : Batuan Teralterasi

No. Urut : 2
No. Sampel : LP 11 (2)

Foto



Lensa Okuler : 10x Lensa Objektif : 5x Perbesaran Total : 50x

Tipe Batuan : Batuan Beku
Tipe Struktur : Vesicle

Deskripsi Mikroskopis :
Kenampakan sayatan batuan pada warna absorbsi *colorless*, nikol silang abu-abu kehitaman, granularitas porfiritik, kristanilitas hipokristalin, relasi inequigranular, bentuk mineral euhedral-subhedral, tekstur intergrowth.

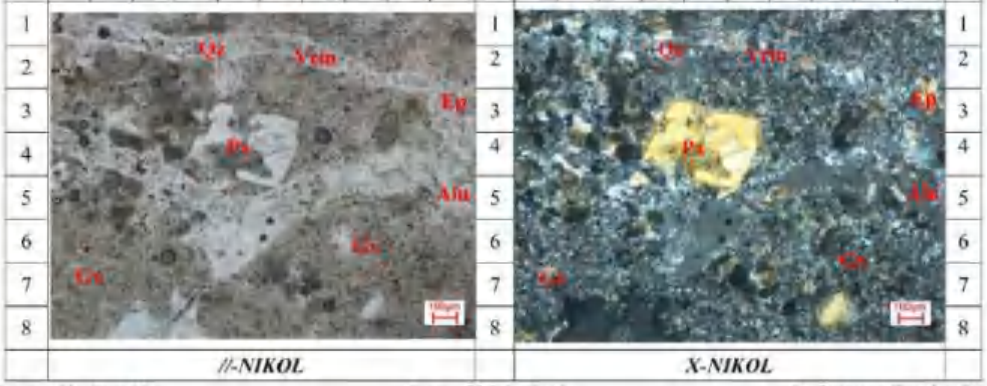
Deskripsi Mineralogi

Komposisi Mineral	Jumlah (%)	Keterangan Optik Mineral
Kaolin (K)	40%	Warna absorbsi *colorless*, belahan tidak ada, intensitas tinggi, relief rendah, indeks bias $n_{min} > n_{cb}$, pleokroisme lemah, pecahan tidak ada, bentuk subhedral-anhedral, warna interferensi, abu kehitaman, kembaran tidak ada, sudut gelapan 12°, jenis gelapan miring, dengan ukuran mineral 0,8-1,3 mm.
Kuarsa (Qz)	20%	Warna absorbsi *colorless*, belahan tidak ada, intensitas tinggi, relief rendah, indeks bias $n_{min} > n_{cb}$, pleokroisme lemah, pecahan tidak ada, bentuk subhedral-anhedral, warna interferensi putih, kembaran tidak ada, sudut gelapan 3°, jenis gelapan bergelombang, dengan ukuran mineral 0,1-0,3 mm.
Ortoklas (Ort)	35%	Warna absorbsi *colorless*, belahan tidak ada, intensitas tinggi, relief rendah, indeks bias $n_{min} > n_{cb}$, pleokroisme lemah, pecahan tidak ada, bentuk euhedral-subhedral, warna interferensi abu-abu kehitaman, kembaran carlsbad, sudut gelapan 12°, jenis gelapan miring, dengan ukuran mineral 0,6-1,3 mm.
Mineral Opaq (Opq)	5%	Warna absorbsi hitam, bentuk subhedral-anhedral, warna interferensi hitam, dengan ukuran mineral 0,1-0,4 mm.

Nama Batuan : Batuan Teralterasi

No. Urut : 3
No. Sampel : LP 47 (1)

Foto



Lensa Okuler : 10x Lensa Objektif : 5x Perbesaran Total : 50x

Tipe Batuan : Batuan Beku
Tipe Struktur : Vesicle

Deskripsi Mikroskopis :
Kenampakan sayatan batuan pada warna absorbsi *colorless*, nikol silang abu-abu kehitaman, granularitas porfiritik, kristanilitas hipokristalin, relasi inequigranular, bentuk mineral subhedral-anhedral, tekstur intergrowth.

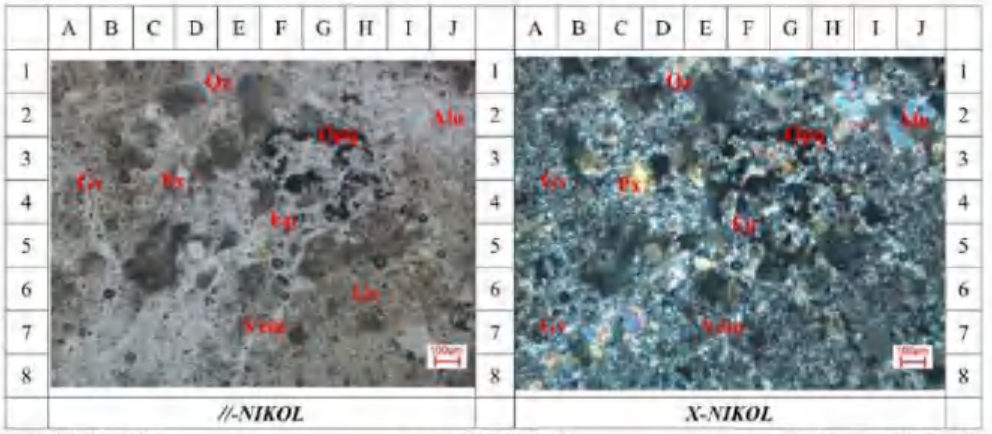
Deskripsi Mineralogi

Komposisi Mineral	Jumlah (%)	Keterangan Optik Mineral
Kuarsa (Qz)	30%	Dijumpai kuarsa pada sayatan tipis berupa vein. Warna absorbsi *colorless*, belahan tidak ada, intensitas tinggi, relief rendah, indeks bias $n_{min} > n_{cb}$, pleokroisme lemah, pecahan tidak ada, bentuk subhedral-anhedral, warna interferensi kuning kecoklatan, kembaran tidak ada, sudut gelapan 3°, jenis gelapan miring, dengan ukuran mineral 0,05 mm – 0,1 mm.
Piroksin (Px)	5%	Warna absorbsi *colorless*, belahan tidak ada, intensitas tinggi, relief tinggi, indeks bias $n_{min} > n_{cb}$, pleokroisme lemah, pecahan tidak ada, bentuk euhedral-subhedral, warna interferensi kuning kecoklatan, kembaran tidak ada, sudut gelapan 38°, jenis gelapan miring, dengan ukuran mineral 0,1-1,5 mm. Jenis piroksin adalah clinopiroksin.
Alunite (Alu)	30%	Warna absorbsi *colorless*, belahan tidak ada, intensitas tinggi, relief rendah, indeks bias $n_{min} > n_{cb}$, pleokroisme kuat, pecahan tidak ada, bentuk subhedral-anhedral, warna interferensi biru keunguan, kembaran tidak ada, sudut gelapan 31°, jenis gelapan miring, dengan ukuran mineral 0,1-0,8 mm.
Epidot (Ep)	2%	Warna absorbsi *colorless*, belahan tidak ada, intensitas tinggi, relief rendah, indeks bias $n_{min} > n_{cb}$, pleokroisme kuat, pecahan tidak ada, bentuk subhedral-anhedral, warna interferensi merah keunguan, kembaran tidak ada, sudut gelapan 27°, jenis gelapan miring, dengan ukuran mineral 0,08-0,1 mm.
Glass vulkanik (Gv)	33%	Warna absorbsi *colorless*, warna interferensi abu kehitaman.

Nama Batuan : Batuan Teralterasi

No. Urut : 3
No. Sampel : LP 47 (2)

Foto



//-NIKOL *X-NIKOL*

Lensa Okuler : 10x Lensa Objektif : 5x Perbesaran Total : 50x

Tipe Batuan : Batuan Beku
Tipe Struktur : Vesicle

Deskripsi Mikroskopis :
Kenampakan sayatan batuan pada warna absorbsi *colorless*, nikol silang abu-abu kehitaman, granularitas porfiritik, kristanilitas hipokristalin, relasi inequigranular, bentuk mineral subhedral-anhedral, tekstur intergrowth.

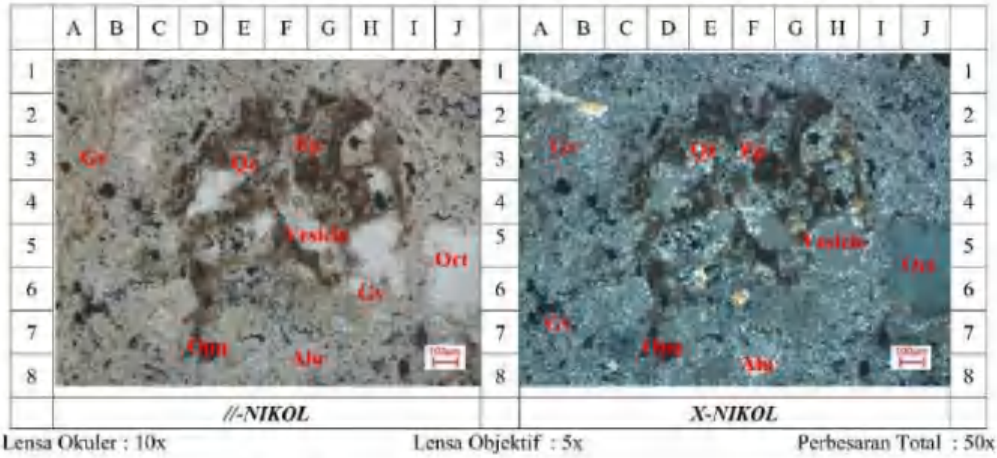
Deskripsi Mineralogi

Komposisi Mineral	Jumlah (%)	Keterangan Optik Mineral
Kuarsa (Qz)	40%	Dijumpai kuarsa pada sayatan tipis berupa vein. Warna absorbsi *colorless*, belahan tidak ada, intensitas tinggi, relief rendah, indeks bias $n_{min} > n_{cb}$, pleokroisme lemah, pecahan tidak ada, bentuk subhedral-anhedral, warna interferensi kuning kecoklatan, kembaran tidak ada, sudut gelapan 4°, jenis gelapan miring, dengan ukuran mineral 0,05 mm – 0,2 mm.
Piroksin (Px)	5%	Warna absorbsi *colorless*, belahan tidak ada, intensitas tinggi, relief tinggi, indeks bias $n_{min} > n_{cb}$, pleokroisme lemah, pecahan tidak ada, bentuk subhedral-anhedral, warna interferensi kuning kecoklatan, kembaran tidak ada, sudut gelapan 25°, jenis gelapan miring, dengan ukuran mineral 0,07-0,1 mm. Jenis piroksin adalah clinopiroksin.
Alunite (Alu)	20%	Warna absorbsi *colorless*, belahan tidak ada, intensitas tinggi, relief rendah, indeks bias $n_{min} > n_{cb}$, pleokroisme kuat, pecahan tidak ada, bentuk subhedral-anhedral, warna interferensi biru keunguan, kembaran tidak ada, sudut gelapan 27°, jenis gelapan miring, dengan ukuran mineral 0,1-0,3 mm.
Epidot (Ep)	1%	Warna absorbsi *colorless*, belahan tidak ada, intensitas tinggi, relief rendah, indeks bias $n_{min} > n_{cb}$, pleokroisme kuat, pecahan tidak ada, bentuk subhedral-anhedral, warna interferensi merah keunguan, kembaran tidak ada, sudut gelapan 18°, jenis gelapan miring, dengan ukuran mineral 0,05-0,1 mm.
Mineral Opaq (Opq)	10%	Warna absorbsi hitam, bentuk subhedral-anhedral, warna interferensi hitam, dengan ukuran mineral 0,05-0,08 mm.
Glass vulkanik (Gv)	24%	Warna absorbsi *colorless*, warna interferensi abu kehitaman.

Nama Batuan : Batuan Teralterasi

No. Urut : 4
No. Sampel : LP 67 (1)

Foto



Lensa Okuler : 10x Lensa Objektif : 5x Perbesaran Total : 50x

Tipe Batuan : Batuan Beku

Tipe Struktur : Vesicle

Deskripsi Mikroskopis :

Kenampakan sayatan batuan pada warna absorbsi *colorless*, nikol silang abu-abu kehitaman, granularitas porfiritik, kristanilitas hipokristalin, relasi inequigranular, bentuk mineral subhedral-anhedral, tekstur intergrowth.

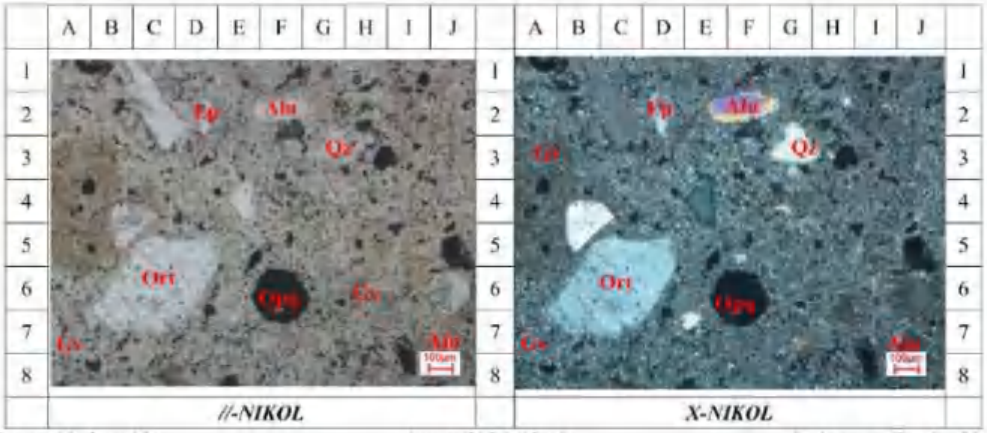
Deskripsi Mineralogi

Komposisi Mineral	Jumlah (%)	Keterangan Optik Mineral
Kuarsa (Qz)	25%	Warna absorbsi *colorless*, belahan tidak ada, intensitas tinggi, relief rendah, indeks bias $n_{min} < n_{cb}$, pleokroisme lemah, pecahan tidak ada, bentuk subhedral-anhedral, warna interferensi kuning kecoklatan, kembaran tidak ada, sudut gelapan 2°, jenis gelapan miring, dengan ukuran mineral 0,05 mm – 0,15 mm.
Ortoklas (Ort)	5%	Warna absorbsi *colorless*, belahan tidak ada, intensitas tinggi, relief rendah, indeks bias $n_{min} < n_{cb}$, pleokroisme lemah, pecahan tidak ada, bentuk euhedral-subhedral, warna interferensi kuning kecoklatan, kembaran carlsbad, sudut gelapan 35°, jenis gelapan miring, dengan ukuran mineral 0,8-1,2 mm.
Alunite (Alu)	10%	Warna absorbsi *colorless*, belahan tidak ada, intensitas tinggi, relief rendah, indeks bias $n_{min} > n_{cb}$, pleokroisme kuat, pecahan tidak ada, bentuk subhedral-anhedral, warna interferensi biru keunguan, kembaran tidak ada, sudut gelapan 17°, jenis gelapan miring, dengan ukuran mineral 0,1-0,2 mm.
Epidot (Ep)	2%	Warna absorbsi *colorless*, belahan tidak ada, intensitas tinggi, relief rendah, indeks bias $n_{min} > n_{cb}$, pleokroisme kuat, pecahan tidak ada, bentuk subhedral-anhedral, warna interferensi merah keunguan, kembaran tidak ada, sudut gelapan 30°, jenis gelapan miring, dengan ukuran mineral 0,1-0,2 mm.
Mineral Opaq (Opq)	15%	Warna absorbsi hitam, bentuk subhedral-anhedral, warna interferensi hitam, dengan ukuran mineral 0,05-0,1 mm.
Glass vulkanik (Gv)	43%	Warna absorbsi *colorless*, warna interferensi abu kehitaman.

Nama Batuan : Batuan Teralterasi

No. Urut : 4
No. Sampel : LP 67 (2)

Foto



Lensa Okuler : 10x Lensa Objektif : 5x Perbesaran Total : 50x

Tipe Batuan : Batuan Beku
Tipe Struktur : Vesicle

Deskripsi Mikroskopis :
Kenampakan sayatan batuan pada warna absorbsi *colorless*, nikol silang abu-abu kehitaman, granularitas porfiritik, kristanilitas hipokristalin, relasi inequigranular, bentuk mineral euhedral-subhedral, tekstur intergrowth.

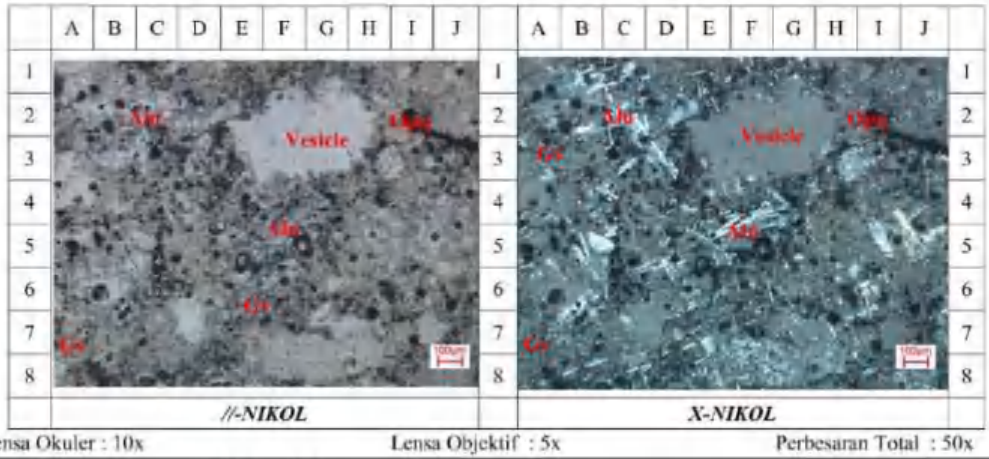
Deskripsi Mineralogi

Komposisi Mineral	Jumlah (%)	Keterangan Optik Mineral
Kuarsa (Qz)	10%	Warna absorbsi *colorless*, belahan tidak ada, intensitas tinggi, relief rendah, indeks bias $n_{min} > n_{cb}$, pleokroisme lemah, pecahan tidak ada, bentuk subhedral-anhedral, warna interferensi kuning kecoklatan, kembaran tidak ada, sudut gelapan 3°, jenis gelapan miring, dengan ukuran mineral 0,05 mm – 0,1 mm.
Ortoklas (Ort)	10%	Warna absorbsi *colorless*, belahan tidak ada, intensitas tinggi, relief rendah, indeks bias $n_{min} > n_{cb}$, pleokroisme lemah, pecahan tidak ada, bentuk euhedral-subhedral, warna interferensi kuning kecoklatan, kembaran carlsbad, sudut gelapan 40°, jenis gelapan miring, dengan ukuran mineral 0,8-1 mm.
Alunite (Alu)	5%	Warna absorbsi *colorless*, belahan tidak ada, intensitas tinggi, relief rendah, indeks bias $n_{min} > n_{cb}$, pleokroisme kuat, pecahan tidak ada, bentuk subhedral-anhedral, warna interferensi biru keunguan, kembaran tidak ada, sudut gelapan 28°, jenis gelapan miring, dengan ukuran mineral 0,1-0,5 mm
Epidot (Ep)	2%	Warna absorbsi *colorless*, belahan tidak ada, intensitas tinggi, relief rendah, indeks bias $n_{min} > n_{cb}$, pleokroisme kuat, pecahan tidak ada, bentuk subhedral-anhedral, warna interferensi merah keunguan, kembaran tidak ada, sudut gelapan 32°, jenis gelapan miring, dengan ukuran mineral 0,08-0,12 mm.
Mineral Opaq (Opq)	20%	Warna absorbsi hitam, bentuk subhedral-anhedral, warna interferensi hitam, dengan ukuran mineral 0,6-0,8 mm.
Glass vulkanik (Gv)	53%	Warna absorbsi *colorless*, warna interferensi abu kehitaman.

Nama Batuan : Batuan Teralterasi

No. Urut : 5
No. Sampel : LP 42 (1)

Foto



Lensa Okuler : 10x Lensa Objektif : 5x Perbesaran Total : 50x

Tipe Batuan : Batuan Beku

Tipe Struktur : Vesicle

Deskripsi Mikroskopis :
Kenampakan sayatan batuan pada warna absorbsi *colorless*, nikol silang abu-abu kehitaman, granularitas porfiritik, kristanilitas hipokristalin, relasi inequigranular, bentuk mineral subhedral-anhedral, tekstur intergrowth.

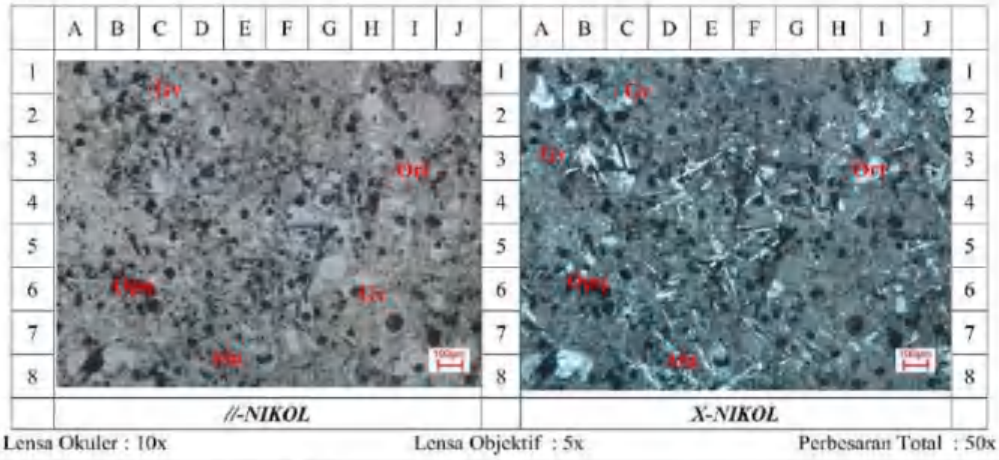
Deskripsi Mineralogi

Komposisi Mineral	Jumlah (%)	Keterangan Optik Mineral
Alunite (Alu)	70%	Warna absorbsi *colorless*, belahan tidak ada, intensitas tinggi, relief rendah, indeks bias $n_{min} > n_{cb}$, pleokroisme kuat, pecahan tidak ada, bentuk subhedral-anhedral, warna interferensi abu kehitaman, kembaran tidak ada, sudut gelapan 29°, jenis gelapan miring, dengan ukuran mineral 0,05-0,02 mm.
Mineral Opaq (Opq)	10%	Warna absorbsi hitam, bentuk subhedral-anhedral, warna interferensi hitam, dengan ukuran mineral 0,05-0,2 mm.
Glass vulkanik (Gv)	20%	Warna absorbsi *colorless*, warna interferensi abu kehitaman.

Nama Batuan : Batuan Teralterasi

No. Urut : 5
No. Sampel : LP 42 (2)

Foto



Lensa Okuler : 10x Lensa Objektif : 5x Perbesaran Total : 50x

Tipe Batuan : Batuan Beku

Tipe Struktur : Vesicle

Deskripsi Mikroskopis :

Kenampakan sayatan batuan pada warna absorbsi *colorless*, nikol silang abu-abu kehitaman, granularitas porfiritik, kristanilitas hipokristalin, relasi inequigranular, bentuk mineral subhedral-anhedral, tekstur intergrowth.

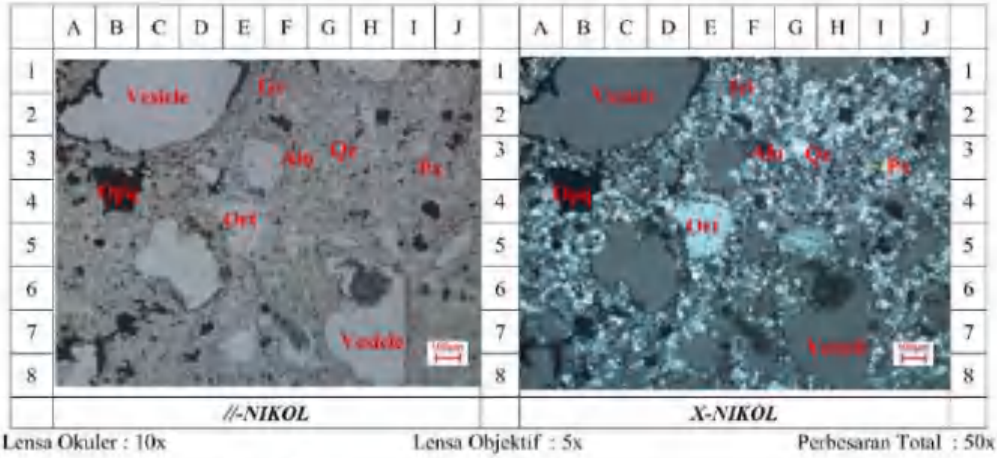
Deskripsi Mineralogi

Komposisi Mineral	Jumlah (%)	Keterangan Optik Mineral
Ortoklas (Ort)	5%	Warna absorbsi *colorless*, belahan tidak ada, intensitas tinggi, relief rendah, indeks bias $n_{min} > n_{cb}$, pleokroisme lemah, pecahan tidak ada, bentuk subhedral-anhedral, warna interferensi abu kehitaman, kembaran carlsbad, sudut gelapan 27°, jenis gelapan miring, dengan ukuran mineral 0,5-0,8 mm.
Alunite (Alu)	60%	Warna absorbsi *colorless*, belahan tidak ada, intensitas tinggi, relief rendah, indeks bias $n_{min} > n_{cb}$, pleokroisme kuat, pecahan tidak ada, bentuk subhedral-anhedral, warna interferensi abu kehitaman, kembaran tidak ada, sudut gelapan 32°, jenis gelapan miring, dengan ukuran mineral 0,05-0,1 mm.
Mineral Opaq (Opq)	15%	Warna absorbsi hitam, bentuk subhedral-anhedral, warna interferensi hitam, dengan ukuran mineral 0,1-0,3 mm.
Glass vulkanik (Gv)	20%	Warna absorbsi *colorless*, warna interferensi abu kehitaman.

Nama Batuan : Batuan Teralterasi

No. Urut : 6
No. Sampel : LP 31 (1)

Foto



Lensa Okuler : 10x Lensa Objektif : 5x Perbesaran Total : 50x

Tipe Batuan : Batuan Beku
Tipe Struktur : Vesicle

Deskripsi Mikroskopis :
Kenampakan sayatan batuan pada warna absorbsi *colorless*, nikol silang abu-abu kehitaman, granularitas porfiritik, kristanilitas hipokristalin, relasi inequigranular, bentuk mineral subhedral-anbhedral, tekstur intergrowth.

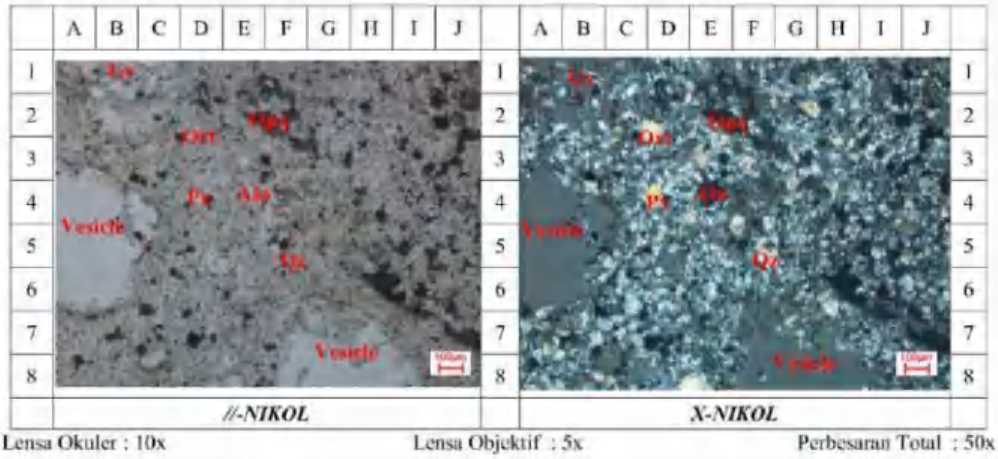
Deskripsi Mineralogi

Komposisi Mineral	Jumlah (%)	Keterangan Optik Mineral
Ortoklas (Ort)	5%	Warna absorbsi *colorless*, belahan tidak ada, intensitas tinggi, relief rendah, indeks bias $n_{min} > n_{cb}$, pleokroisme lemah, pecahan tidak ada, bentuk euhedral-subhedral, warna interferensi abu kehitaman, kembaran carlsbad, sudut gelapan 41°, jenis gelapan miring, dengan ukuran mineral 0,1-0,8 mm.
Piroksin (Px)	2%	Warna absorbsi *colorless*, belahan tidak ada, intensitas tinggi, relief tinggi, indeks bias $n_{min} > n_{cb}$, pleokroisme lemah, pecahan tidak ada, bentuk subhedral-anhedral, warna interferensi kuning kecoklatan, kembaran tidak ada, sudut gelapan 34°, jenis gelapan miring, dengan ukuran mineral 0,05-0,1 mm. Jenis piroksin adalah clinopiroksin.
Kuarsa (Qz)	70%	Warna absorbsi *colorless*, belahan tidak ada, intensitas tinggi, relief rendah, indeks bias $n_{min} > n_{cb}$, pleokroisme lemah, pecahan tidak ada, bentuk subhedral-anhedral, warna interferensi kuning kecoklatan, kembaran tidak ada, sudut gelapan 3°, jenis gelapan miring, dengan ukuran mineral 0,05 mm – 0,1 mm.
Alunite (Alu)	2%	Warna absorbsi *colorless*, belahan tidak ada, intensitas tinggi, relief rendah, indeks bias $n_{min} > n_{cb}$, pleokroisme kuat, pecahan tidak ada, bentuk subhedral-anhedral, warna interferensi biru keunguan, kembaran tidak ada, sudut gelapan 22°, jenis gelapan miring, dengan ukuran mineral 0,05-0,1 mm.
Mineral Opaq (Opq)	5%	Warna absorbsi hitam, bentuk subhedral-anhedral, warna interferensi hitam, dengan ukuran mineral 0,1-0,5 mm.
Glass vulkanik (Gv)	16%	Warna absorbsi *colorless*, warna interferensi abu kehitaman.

Nama Batuan : Batuan Teralterasi

No. Urut : 6
No. Sampel : LP 31 (2)

Foto



Lensa Okuler : 10x Lensa Objektif : 5x Perbesaran Total : 50x

Tipe Batuan : Batuan Beku
Tipe Struktur : Vesicle

Deskripsi Mikroskopis :
Kenampakan sayatan batuan pada warna absorbsi *colorless*, nikol silang abu-abu kehitaman, granularitas porfiritik, kristanilitas hipokristalin, relasi inequigranular, bentuk mineral subhedral-anhedral, tekstur intergrowth.

Deskripsi Mineralogi

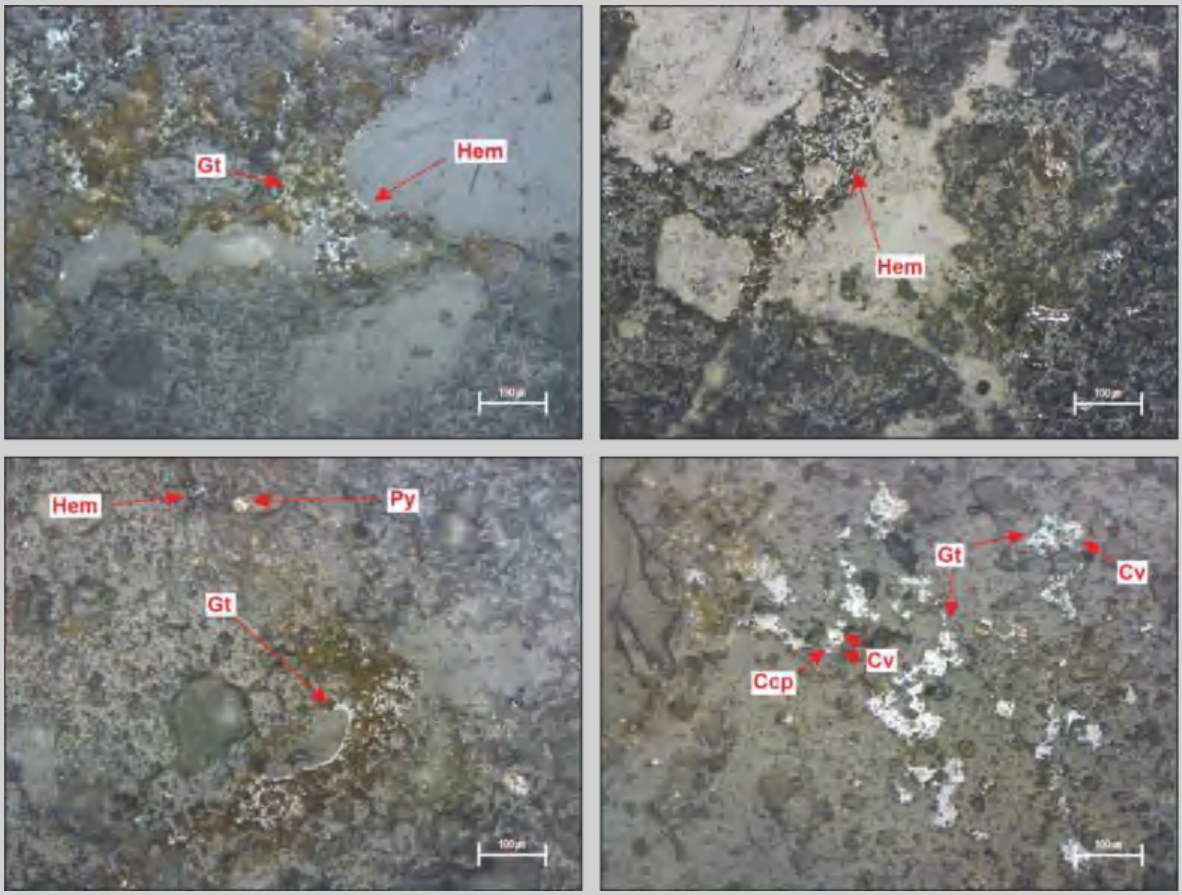
Komposisi Mineral	Jumlah (%)	Keterangan Optik Mineral
Ortoklas (Ort)	5%	Warna absorbsi *colorless*, belahan tidak ada, intensitas tinggi, relief rendah, indeks bias $n_{min} > n_{cb}$, pleokroisme lemah, pecahan tidak ada, bentuk subhedral-anhedral, warna interferensi abu kehitaman, kembaran carlsbad, sudut gelapan 38°, jenis gelapan miring, dengan ukuran mineral 0,05-0,3 mm.
Piroksin (Px)	2%	Warna absorbsi *colorless*, belahan tidak ada, intensitas tinggi, relief tinggi, indeks bias $n_{min} > n_{cb}$, pleokroisme lemah, pecahan tidak ada, bentuk subhedral-anhedral, warna interferensi kuning kecoklatan, kembaran tidak ada, sudut gelapan 29°, jenis gelapan miring, dengan ukuran mineral 0,05-0,1 mm. Jenis piroksin adalah clinopiroksin
Kuarsa (Qz)	50%	Dijumpai kuarsa pada sayatan tipis berupa vein. Warna absorbsi *colorless*, belahan tidak ada, intensitas tinggi, relief rendah, indeks bias $n_{min} > n_{cb}$, pleokroisme lemah, pecahan tidak ada, bentuk subhedral-anhedral, warna interferensi kuning kecoklatan, kembaran tidak ada, sudut gelapan 3°, jenis gelapan miring, dengan ukuran mineral 0,05 mm – 0,1 mm.
Alunite (Alu)	3%	Warna absorbsi *colorless*, belahan tidak ada, intensitas tinggi, relief rendah, indeks bias $n_{min} > n_{cb}$, pleokroisme kuat, pecahan tidak ada, bentuk subhedral-anhedral, warna interferensi biru keunguan, kembaran tidak ada, sudut gelapan 15°, jenis gelapan miring, dengan ukuran mineral 0,05-0,08 mm.
Mineral Opaq (Opq)	15%	Warna absorbsi hitam, bentuk subhedral-anhedral, warna interferensi hitam, dengan ukuran mineral 0,1-0,8 mm.
Glass vulkanik (Gv)	25%	Warna absorbsi *colorless*, warna interferensi abu kehitaman.

Nama Batuan : Batuan Teralterasi

Lampiran 2 Analisis mineragrafi

No. Sampel : LP 31

Foto



Lensa Okuler : 10x Lensa Objektif : 10x Perbesaran Total : 100x

Tipe Endapan : Epitermal (*High Sulphidation*)

Jenis Mineralisasi : Pirit – kalkopirit – kovelit – Hematit – Goetit

Referensi : Ore Mineral Atlas (Marshall, 2004)

Mikroskopis :

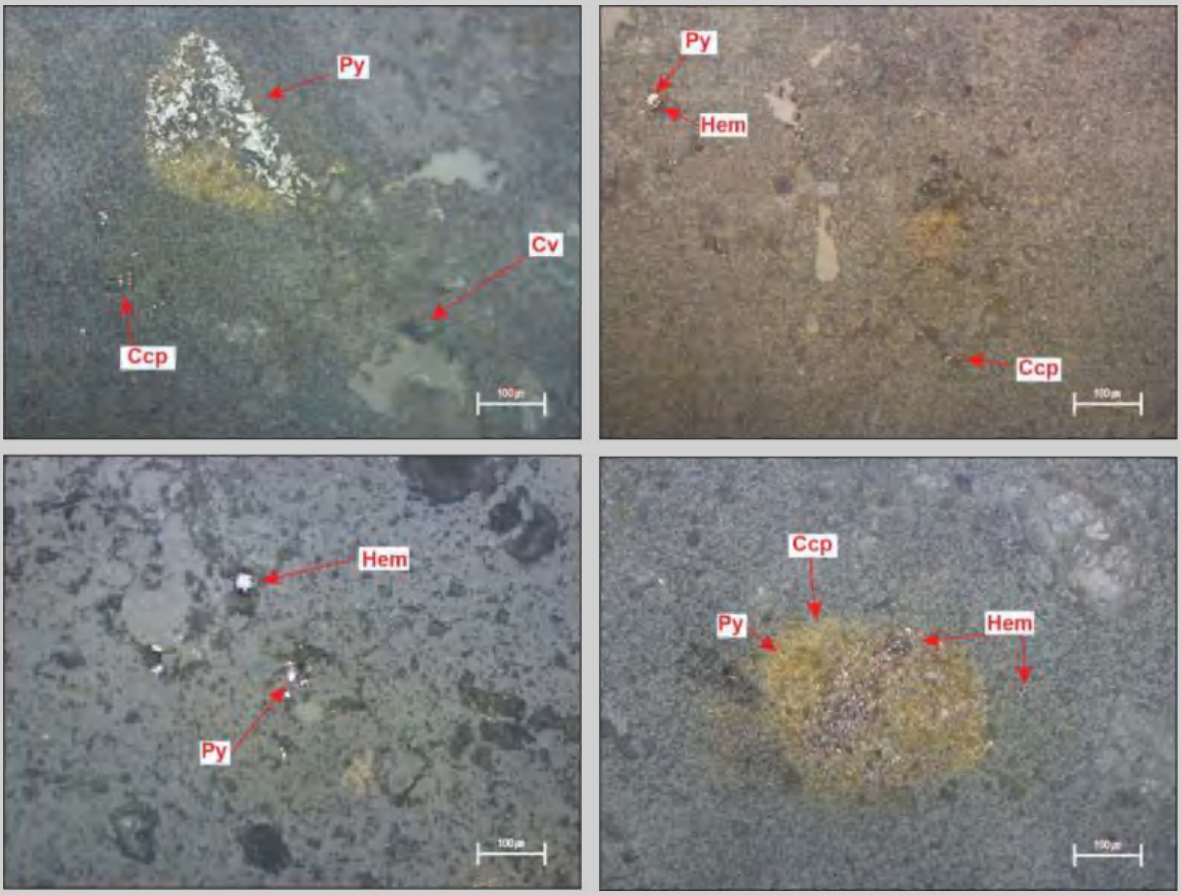
Kenampakan pada sayatan poles memperlihatkan mineral yang terdiri dari pirit, kalkopirit, kovelit, hematit, dan goetit dengan tekstur *interlock* dan *replacement*. Mineral pirit dan kalkopirit hadir dengan menyebar (*disaminated*). Mineral hematit dan goetit hadir mengisi rekahan batuan. Mineral kovelit menggantikan mineral kalkopirit, mineral oksida hematit dan goetit menggantikan mineral sulfida.

Deskripsi Mineralogi

Komposisi Mineral	Keterangan Optik Mineral
Pirit (Py) (FeS2)	Berwarna putih kekuningan, bentuk anhedral, ukuran 0,02 mm -0,2 mm, memiliki tekstur *interlock* dengan kalkopirit, bersifat isotropik dan tidak dijumpai adanya pleokroisme.
Kalkopirit (Ccp) (CuFeS2)	Berwarna kuning, bentuk anhedral, ukuran <0,01 mm – 0,02 m, memiliki tekstur *interlock* terhadap pirit, bersifat isotropik dan tidak dijumpai adanya pleokroisme.
Kovelit (Cv) (CuS)	Berwarna Biru, Bentuk anhedral-subhedral, ukuran mineral <0,01 mm, tekstur replacment terhadap kalkopirit, bersifat isotropik dan tidak dijumpai adanya pleokroisme.
em)	Berwarna putih dan kemerahan, bentuk anhedral-subhedral, ukuran mineral 0,02 mm – 0,1 mm dengan tekstur *replacement* terhadap mineral pirit dengan sifat *openspace filling,* bersifat isotropik dan tidak dijumpai adanya pleokroisme.
t)))	Berwarna putih dan kecoklatan, bentuk anhedral, ukuran mineral 0,1 mm-0,4 mm, bentuk anhedral tekstur *replacement* dan *open space filling*, bersifat isotropik dan tidak dijumpai adanya pleokroisme.

No. Sampel : LP 67

Foto



Lensa Okuler : 10x Lensa Objektif : 10x Perbesaran Total : 100x

Tipe Endapan : Epitermal (*High Sulphidation*)

Jenis Mineralisasi : Pirit – kalkopirit – kovelit – Hematit – Goetit

Referensi : Ore Mineral Atlas (Marshall, 2004)

Mikroskopis :

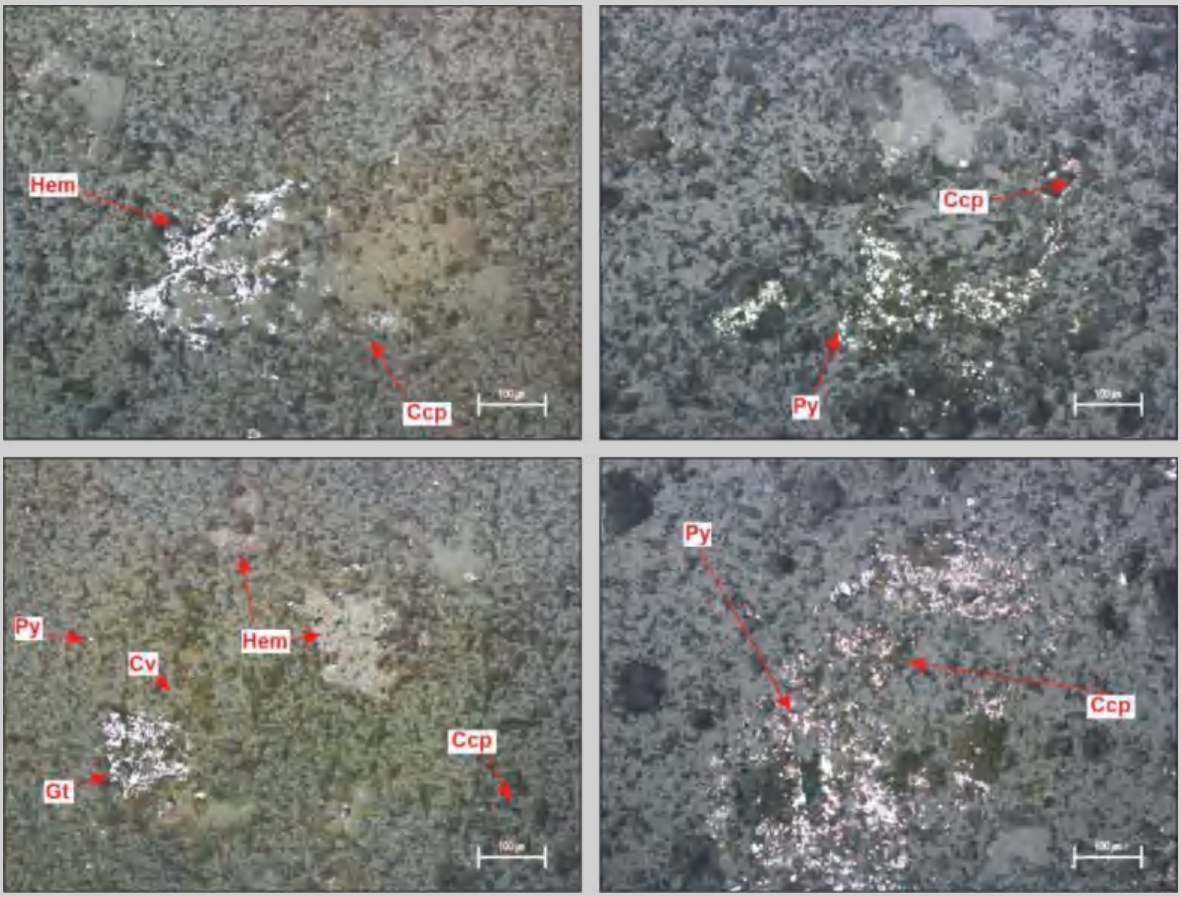
Kenampakan pada sayatan poles memperlihatkan mineral yang terdiri dari Pirit, Kalkopirit, kovelit, dan hematit dengan tekstur *intergrowth* dan *replacement*. Mineral pirit dan kalkopirit hadir dengan menyebar (*disaminated*). Mineral kovelit menggantikan mineral kalkopirit, mineral oksida hematit dan goetit menggantikan mineral sulfida.

Deskripsi Mineralogi

Komposisi Mineral	Keterangan Optik Mineral
Pirit (Py) (FeS2)	Berwarna putih kekuningan, bentuk anhedral, ukuran 0,02 mm -0,2 mm, memiliki tekstur *intergrowth* dengan mineral kalkopirit, *disseminated,* bersifat isotropik dan tidak dijumpai adanya pleokroisme.
Kalkopirit (Ccp) (CuFeS2)	Berwarna kuning, bentuk anhedral, ukuran <0,01 mm – 0,02 m, memiliki tekstur *intergrowth* terhadap pirit, bersifat isotropik dan tidak dijumpai adanya pleokroisme.
Kovelit (Cv) (CuS)	Berwarna Biru, Bentuk anhedral-subhedral, ukuran mineral <0,01 mm, tekstur *replacement* terhadap kalkopirit, bersifat isotropik dan tidak dijumpai adanya pleokroisme.
em)	Berwarna putih dan kemerahan, bentuk anhedral-subhedral, ukuran mineral 0,02 mm – 0,1 mm, dengan tekstur *replacement* terhadap mineral pirit dengan sifat *openspace filling,* bersifat isotropik dan tidak dijumpai adanya pleokroisme.

No. Sampel : LP 47

Foto



Lensa Okuler : 10x Lensa Objektif : 10x Perbesaran Total : 100x

Tipe Endapan : Epitermal (*High Sulphidation*)

Jenis Mineralisasi : Pirit – kalkopirit – kovelit – Hematit – Goetit

Referensi : Ore Mineral Atlas (Marshall, 2004)

Mikroskopis :

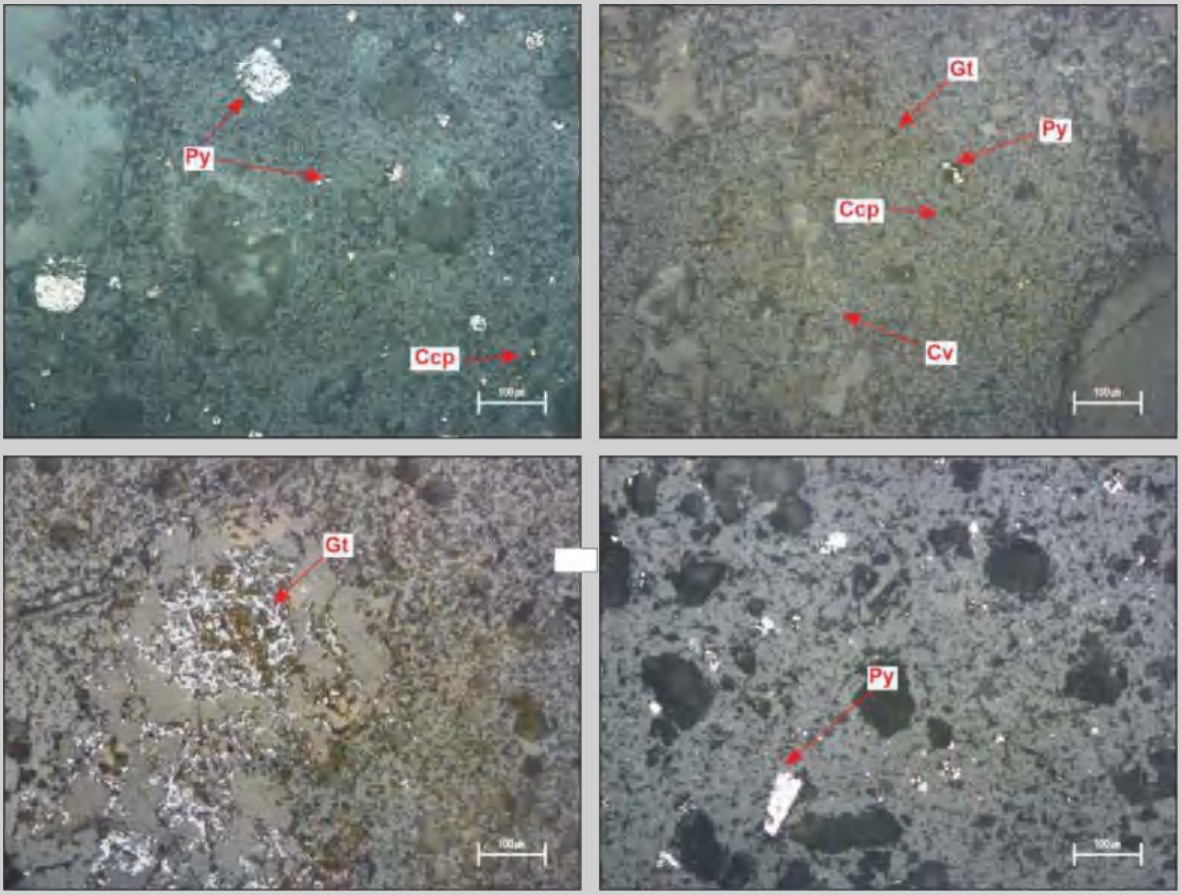
Kenampakan pada sayatan poles memperlihatkan mineral yang terdiri dari Pirit, Kalkopirit, kovelit, hematit, dan goetit dengan tekstur *interlock* dan *replacement*. Mineral hematit dan goetit hadir mengisi rekahan batuan. Mineral kovelit menggantikan mineral pirit, mineral oksida hematit dan goetit menggantikan mineral sulfida.

Deskripsi Mineralogi

Komposisi Mineral	Keterangan Optik Mineral
Pirit (Py) (FeS2)	Berwarna putih kekuningan, bentuk anhedral, ukuran 0,02 mm -0,2 mm, memiliki tekstur *interlock* dengan kalkopirit, bersifat isotropik dan tidak dijumpai adanya pleokroisme.
Kalkopirit (Ccp) (CuFeS2)	Berwarna kuning, bentuk anhedral, ukuran <0,01 mm – 0,02 m, memiliki tekstur *interlock* dengan pirit, bersifat isotropik dan tidak dijumpai adanya pleokroisme.
Kovelit (Cv) (CuS)	Berwarna Biru, Bentuk anhedral-subhedral, ukuran mineral <0,01 mm, tekstur *replacement* terhadap kalkopirit, bersifat isotropik dan tidak dijumpai adanya pleokroisme.
em)	Berwarna putih dan kemerahan, bentuk anhedral-subhedral, ukuran mineral 0,02 mm – 0,1 mm dengan tekstur *replacement* terhadap mineral pirit dengan sifat *openspace filling*, bersifat isotropik dan tidak dijumpai adanya pleokroisme.
h)))	Berwarna putih dan kecoklatan, bentuk anhedral, ukuran mineral 0,1 mm-0,4 mm, bentuk anhedral, tekstur *replacement* , *openspace filling,* bersifat isotropik dan tidak dijumpai adanya pleokroisme.

No. Sampel : LP 11

Foto



Lensa Okuler : 10x Lensa Objektif : 10x Perbesaran Total : 100x

Tipe Endapan : Epitermal (*High Sulphidation*)

Jenis Mineralisasi : Pirit – kalkopirit – kovelit – Hematit – Goetit

Referensi : Ore Mineral Atlas (Marshall, 2004)

Mikroskopis :

Kenampakan pada sayatan poles memperlihatkan mineral yang terdiri dari Pirit, Kalkopirit, kovelit, dan goetit dengan tekstur *intergrowth* dan *replacement*. Mineral pirit dan kalkopirit hadir dengan menyebar (*disaminated*). Mineral goetit hadir mengisi rekahan batuan. Mineral kovelit menggantikan mineral kalkopirit, mineral oksida hematit dan goetit menggantikan mineral pirit.

Deskripsi Mineralogi

Komposisi Mineral	Keterangan Optik Mineral
Pirit (Py) (FeS2)	Berwarna putih kekuningan, bentuk anhedral, ukuran 0,02 mm -0,2 mm, memiliki tekstur *intergrowth* dengan mineral kalkopirit, dengan sifat *disseminated,* bersifat isotropik dan tidak dijumpai adanya pleokroisme.
Kalkopirit (Ccp) (CuFeS2)	Berwarna kuning, bentuk anhedral, ukuran <0,01 mm – 0,02 m, memiliki tekstur *intergrowth* dengan pirit bersifat isotropik dan tidak dijumpai adanya pleokroisme.
Kovelit (Cv)	Berwarna Biru, Bentuk anhedral-subhedral, ukuran mineral <0,01 mm, tekstur *replacement* terhadap kalkopirit, bersifat isotropik dan tidak dijumpai adanya pleokroisme.
em)	Berwarna putih dan kemerahan, bentuk anhedral-subhedral, ukuran mineral 0,02 mm – 0,1 mm dengan tekstur *replacement* terhadap mineral pirit dengan sifat *openspace filling,* bersifat isotropik dan tidak dijumpai adanya pleokroisme.
t)))	Berwarna putih dan kecoklatan, bentuk anhedral, ukuran mineral 0,1 mm-0,4 mm, bentuk anhedral tekstur *replacement*, bersifat isotropik dan tidak dijumpai adanya pleokroisme

Lampiran 3 Analisis XRD

LP 1

Match! Phase Analysis Report

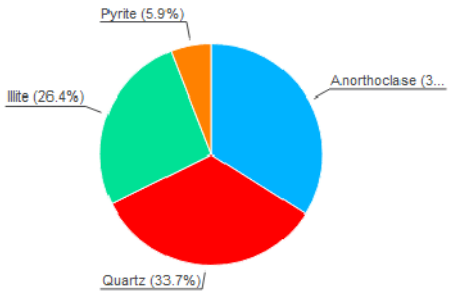
Sample: MRC-675-1-2-24-AR (5-70)

Sample Data

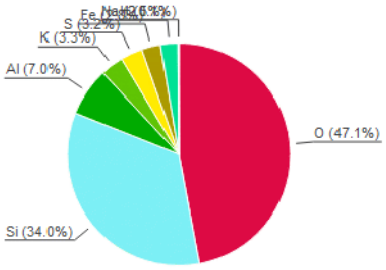
File name	MRC-675-1-2-24-AR.RAW
File path	D:/age/MRC-675-1-2-24-AR
Data collected	Jun 11, 2024 15:29:01
Data range	5.000° - 70.000°
Original data range	5.000° - 70.000°
Number of points	3251
Step size	0.020
Rietveld refinement converged	No
Alpha2 subtracted	No
Background subtr.	No
Data smoothed	Yes
Radiation	X-rays
Wavelength	1.540600 Å

Analysis Results

Phase composition (Weight %) calc. by RIR method



Elemental composition (Weight %) calc. by RIR method



Index	*Amount (%)*	*Name*	*Formula sum*
A	34.0	Anorthoclase	Al K0.15 Na0.85 O8 Si3
B	33.7	Quartz	O2 Si
C	26.4	Illite	Al2 H2 K O12 Si4
D	5.9	Pyrite	Fe S2
	12.1	*Unidentified peak area*	

Amounts calculated by RIR (Reference Intensity Ratio) method

Element	*Amount (weight %)*
O	*47.1%(*)*
Si	34.0%
Al	7.0%
K	3.3%
S	3.2%
Fe	2.8%
Na	2.5%
H	0.1%(*)
**LE (sum)*	*47.2%*

Details of identified phases

A: Anorthoclase (34.0 %)*

Formula sum	Al K0.15 Na0.85 O8 Si3
Entry number	96-900-0860
Figure-of-Merit (FoM)	0.603991*
Total number of peaks	249
Peaks in range	249
Peaks matched	92
Intensity scale factor	0.22
2theta correction	-0.091°
Space group	C -1
Crystal system	triclinic (anorthic)
Unit cell	a= 8.2168 Å b= 12.9166 Å c= 7.1270 Å α= 92.754° β= 116.357 ° γ= 90.239 °
I/Ic	0.58
Calc. density	2.597 g/cm³
Reference	Harlow G. E., "The anorthoclase structures: The effects of temperature and compositionKakanui, Or = 13.8, T =

23 deg Cfeldspar", American Mineralogist **67**, 975-996 (1982)

B: Quartz (33.7 %)*

Formula sum	O2 Si
Entry number	96-900-0776
Figure-of-Merit (FoM)	0.835108*
Total number of peaks	71
Peaks in range	18
Peaks matched	15
Intensity scale factor	1.09
2theta correction	-0.037°
Space group	P 32 2 1 S
Crystal system	trigonal (hexagonal axes)
Unit cell	a= 4.9160 Å c= 5.4054 Å
I/Ic	2.95
Calc. density	2.646 g/cm³
Reference	Levien L., Prewitt C. T., Weidner D. J., "Structure and elastic properties of quartz at pressureP = 1 atm", American Mineralogist **65**, 920-930 (1980)

C: Illite (26.4 %)*

Formula sum	Al2 H2 K O12 Si4
Entry number	96-901-3723
Figure-of-Merit (FoM)	0.634612*
Total number of peaks	303
Peaks in range	106
Peaks matched	49
Intensity scale factor	0.23
2theta correction	-0.037°
Space group	C 1 2/m 1
Crystal system	monoclinic
Unit cell	a= 5.2350 Å b= 9.0320 Å c= 10.1400 Å β= 101.520 °
I/Ic	0.79
Calc. density	2.824 g/cm³
Reference	Drits V. A., Zviagina B. B., McCarty D. K., Salyn A. L., "Factors responsible for crystal-chemical variations in the solid solutionsfrom illite to aluminoceladonite and from glauconite to celadoniteSample Name: 60", American Mineralogist **95**, 348-361 (2010)

D: Pyrite (5.9 %)*

Formula sum	Fe S2
Entry number	96-901-5843
Figure-of-Merit (FoM)	0.781765*
Total number of peaks	29
Peaks in range	9
Peaks matched	9
Intensity scale factor	0.21
2theta correction	0.019°
Space group	P a -3
Crystal system	cubic
Unit cell	a= 5.4140 Å
I/Ic	3.29
Calc. density	5.022 g/cm³
Reference	Oftedal I., "Uber die Kristallstrukturen der verbindungen RuS2, OsS2, MnTe2 und AuSb2.Mit einem Anhang uber die Gitterkonstant von Pyrit", Zeitschrift fur Physikalische Chemie **135**, 291-299 (1928)

(*)2theta values have been shifted internally for the calculation of the amounts, the intensity scaling factors as well as the figure-of-merit (FoM), due to the active search-match option 'Automatic zero point adaption'.

Search-Match

Settings

Reference database used	COD-Inorg 2024.06.03
Method	Peak-based search-match
Automatic zeropoint adaptation	Yes
Downgrade entries with low scaling factors	Yes
Minimum figure-of-merit (FoM)	0.50
2theta window for peak corr.	0.30 deg.
Minimum rel. int. for peak corr.	0
Parameter/influence 2theta	0.50
Parameter/influence intensities	0.50
Parameter multiple/single phase(s)	0.50

Peak List

No.	2theta [°]	d [Å]	I/I0 (peak height)	Counts (peak area)	FWHM	Matched
1	5.02	17.5893	46.72	1.04	0.0365	
2	7.12	12.4054	16.74	5.92	0.5783	
3	8.54	10.3456	32.73	22.42	1.1200	
4	8.92	9.9057	0.51	0.10	0.3200	C
5	17.62	5.0294	40.74	8.97	0.3600	
6	17.86	4.9624	32.56	2.95	0.1480	C
7	19.84	4.4714	156.43	39.18	0.4095	A,C
8	20.88	4.2510	181.46	35.51	0.3200	B
9	22.02	4.0334	123.08	25.36	0.3369	A
10	23.70	3.7512	94.98	23.29	0.4010	A
11	24.44	3.6392	101.37	36.05	0.5815	A,C
12	25.34	3.5120	42.72	18.37	0.7032	A
13	26.66	3.3410	1000.00	165.93	0.2713	B,C
14	27.88	3.1975	413.55	102.21	0.4041	A
15	28.48	3.1315	103.80	20.22	0.3186	A,D
16	29.12	3.0641	62.22	26.24	0.6895	C
17	29.66	3.0095	50.78	10.71	0.3449	A
18	30.44	2.9342	95.66	28.68	0.4903	A,C
19	31.44	2.8431	53.91	16.62	0.5041	A
20	33.06	2.7074	160.79	24.32	0.2473	A,D
21	35.02	2.5602	168.99	38.77	0.3751	C
22	36.58	2.4545	137.05	27.42	0.3271	A,B,C
23	37.10	2.4213	151.75	23.85	0.2570	A,D
24	37.56	2.3927	45.31	16.54	0.5968	A,C
25	37.84	2.3757	30.32	5.82	0.3140	A,C
26	39.48	2.2807	80.69	11.91	0.2414	A,B
27	40.26	2.2383	57.27	11.21	0.3200	A,B,C
28	40.78	2.2109	116.00	18.05	0.2545	A,C,D
29	42.46	2.1272	118.75	27.60	0.3800	A,B,C
30	45.78	1.9804	67.01	28.22	0.6886	A,B,C
31	47.44	1.9149	72.91	12.49	0.2800	A,C,D
32	49.38	1.8441	12.00	6.59	0.8980	A
33	50.16	1.8172	153.76	27.44	0.2918	A,B,C
34	50.82	1.7952	19.08	2.13	0.1826	A,B
35	51.44	1.7750	30.25	6.61	0.3574	A
36	54.96	1.6693	51.74	36.35	1.1487	A,B,C
37	56.28	1.6333	164.79	35.37	0.3509	A,C,D
38	59.16	1.5605	29.81	7.86	0.4314	A,C,D
39	59.96	1.5415	104.44	17.89	0.2800	A,B,C
40	61.80	1.5000	101.41	41.53	0.6695	A,C,D
41	62.04	1.4947	9.75	2.01	0.3372	A,C
42	64.22	1.4492	58.17	13.76	0.3867	A,B,C,D
43	67.78	1.3815	65.30	19.17	0.4800	B,C
44	68.26	1.3729	86.54	21.53	0.4068	B,C

Integrated Profile Areas

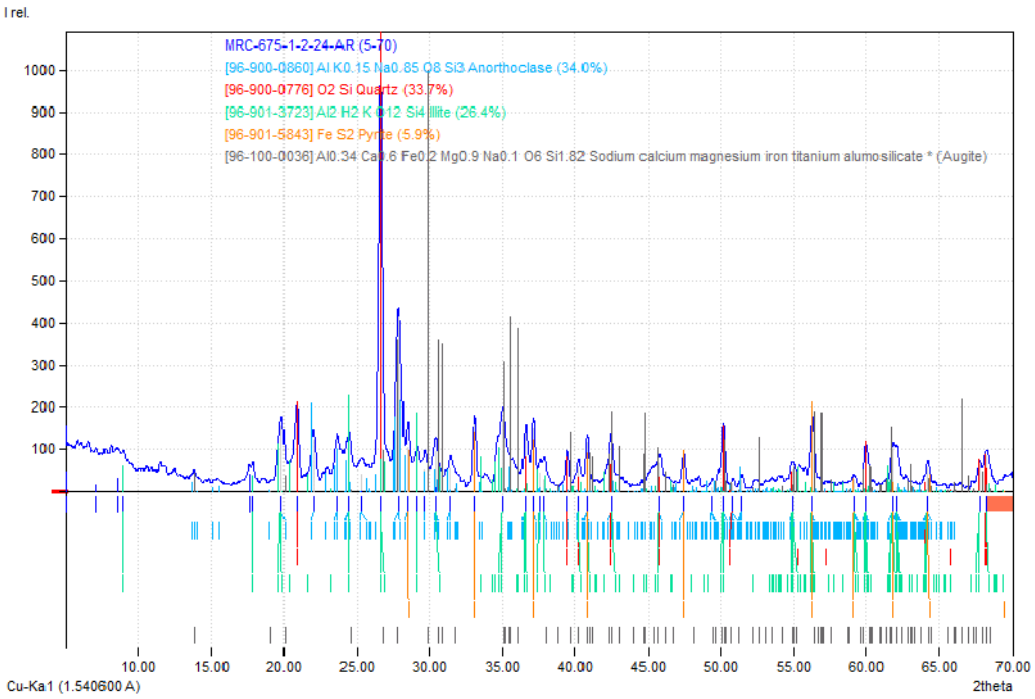
Based on calculated profile

Profile area	Counts	Amount
Overall diffraction profile	93797	100.00%
Background radiation	37031	39.48%
Diffraction peaks	56766	60.52%
Peak area belonging to selected phases	45376	48.38%
Peak area of phase A (Anorthoclase)	*14218*	*15.16%*
Peak area of phase B (Quartz)	*13606*	*14.51%*
Peak area of phase C (Illite)	*12435*	*13.26%*
Peak area of phase D (Pyrite)	*5117*	*5.46%*
Unidentified peak area	11390	12.14%

Peak Residuals

Peak data	Counts	Amount
Overall peak intensity	1074	100.00%
Peak intensity belonging to selected phases	1060	98.71%
Unidentified peak intensity	14	1.29%

Diffraction Pattern Graphics



LP 8

Match! Phase Analysis Report

Sample: MRC-690-15-D-23-05-CAA (5-70)

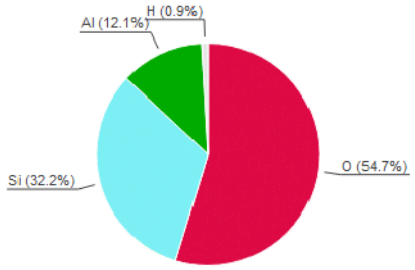
Sample Data

File name	MRC-690-15-DES-23-05-CAA.RAW
File path	D:/FRYAN/XRD AGE/MRC-690-15-DES-23-05-CAA
Data collected	May 9, 2024 20:53:19
Data range	5.000° - 70.000°
Original data range	5.000° - 70.000°
Number of points	3251
Step size	0.020
Rietveld refinement converged	No
Alpha2 subtracted	No
Background subtr.	No
Data smoothed	Yes
Radiation	X-rays
Wavelength	1.540600 Å

Analysis Results

Phase composition (Weight %) calc. by RIR method

Elemental composition (Weight %) calc. by RIR method



Index	*Amount (%)*	*Name*	*Formula sum*
A	42.0	Quartz	O2 Si
B	58.0	Al2Si2O5(OH)4 kaolin	Al2 H4 O9 Si2
	8.9	*Unidentified peak area*	

Element	*Amount (weight %)*
O	*54.7%(*)*
Si	32.2%
Al	12.1%
H	0.9%(*)
**LE (sum)*	*55.6%*

Details of identified phases

A: Quartz (42.0 %)

Formula sum	O2 Si
Entry number	96-901-3322
Figure-of-Merit (FoM)	0.905122
Total number of peaks	35
Peaks in range	18
Peaks matched	17
Intensity scale factor	0.90
Space group	P 32 2 1
Crystal system	trigonal (hexagonal axes)
Unit cell	a= 4.9134 Å c= 5.4051 Å
I/Ic	3.32
Calc. density	2.649 g/cm³
Reference	Antao S. M., Hassan I., Wang J., Lee P. L., Toby B. H., "State-of-the-art high-resolution powder x-ray diffraction (HRPXRD)illustrated with Rietveld structure refinement of quartz, sodalite,tremolite, and meionite Locality: not specified", The Canadian Mineralogist **46**, 1501-1509 (2008)

B: Al2Si2O5(OH)4 kaolin (58.0 %)

Formula sum	Al2 H4 O9 Si2
Entry number	96-154-4873

Figure-of-Merit (FoM)	0.905398
Total number of peaks	289
Peaks in range	140
Peaks matched	94
Intensity scale factor	0.60
Space group	C 1 c 1
Crystal system	monoclinic
Unit cell	a= 8.9200 Å b= 5.1570 Å c= 15.6840 Å β= 113.610 °
I/Ic	1.60
Calc. density	2.553 g/cm³
Reference	Toraya H., Iwai S., Marumo F., "The structural investigation of a kaolin mineral by X-ray powderpattern-fitting", Mineralogical Journal **10**, 168-180 (1980)

Search-Match

Settings

Reference database used	COD-Inorg 2024.06.03
Method	Peak-based search-match
Automatic zeropoint adaptation	Yes
Downgrade entries with low scaling factors	Yes
Minimum figure-of-merit (FoM)	0.50
2theta window for peak corr.	0.30 deg.
Minimum rel. int. for peak corr.	1
Parameter/influence 2theta	0.50
Parameter/influence intensities	0.50
Parameter multiple/single phase(s)	0.50

Peak List

No.	*2theta [°]*	*d [Å]*	*I/I0 (peak height)*	*Counts (peak area)*	*FWHM*	*Matched*
1	12.24	7.2253	334.95	246.56	0.4305	B
2	20.24	4.3839	149.60	171.86	0.6718	B
3	20.78	4.2712	159.82	108.41	0.3967	A
4	21.48	4.1336	158.37	83.62	0.3088	B
5	22.52	3.9450	34.36	13.91	0.2368	B
6	24.76	3.5929	524.86	249.62	0.2781	B
7	25.64	3.4716	49.75	50.04	0.5881	B
8	26.08	3.4140	65.03	65.40	0.5881	B
9	26.66	3.3410	1000.00	425.67	0.2489	A
10	28.60	3.1186	27.39	12.50	0.2669	B
11	29.14	3.0621	80.89	33.55	0.2426	B
12	30.54	2.9248	27.51	14.14	0.3006	B
13	34.86	2.5716	24.43	14.98	0.3585	B
14	35.56	2.5226	53.77	42.76	0.4650	B
15	36.56	2.4558	85.19	84.58	0.5806	A
16	37.00	2.4276	140.81	214.02	0.8888	B
17	37.34	2.4063	116.99	223.14	1.1154	B
18	38.80	2.3191	37.20	70.96	1.1154	B
19	39.48	2.2807	87.73	38.17	0.2544	A,B
20	40.28	2.2372	54.93	25.62	0.2728	A,B
21	42.46	2.1272	73.16	27.31	0.2183	A
22	42.78	2.1121	17.88	6.67	0.2183	B
23	43.20	2.0925	24.18	12.91	0.3121	B
24	43.66	2.0715	32.20	14.66	0.2663	B
25	45.34	1.9986	3.03	1.35	0.2603	B
26	45.84	1.9779	51.58	22.44	0.2544	A,B
27	46.90	1.9357	47.61	24.89	0.3056	B
28	47.36	1.9179	50.40	30.24	0.3509	B
29	47.92	1.8968	44.77	26.31	0.3437	B
30	49.52	1.8392	11.00	4.23	0.2249	B
31	50.14	1.8179	162.71	65.31	0.2347	A,B
32	50.78	1.7965	39.29	21.76	0.3238	A,B
33	51.56	1.7711	18.02	11.15	0.3619	B
34	52.68	1.7361	18.89	9.83	0.3044	B
35	54.54	1.6812	24.17	15.59	0.3772	B
36	54.86	1.6721	54.35	36.47	0.3924	A,B
37	55.30	1.6599	28.27	18.97	0.3924	A,B
38	57.32	1.6061	25.44	15.88	0.3650	A,B
39	57.94	1.5904	18.89	10.35	0.3206	B
40	59.96	1.5415	119.85	55.14	0.2691	A,B
41	62.40	1.4870	107.18	59.62	0.3253	B
42	63.02	1.4738	32.05	33.98	0.6200	B
43	63.70	1.4597	42.41	74.42	1.0261	B
44	64.00	1.4536	37.46	89.68	1.4000	A,B
45	64.82	1.4372	18.67	32.76	1.0261	B
46	67.72	1.3825	67.56	118.55	1.0261	A,B
47	68.16	1.3747	82.56	100.45	0.7114	A
48	68.32	1.3718	89.25	81.96	0.5370	A,B
49	69.12	1.3579	14.83	10.00	0.3944	B

Integrated Profile Areas

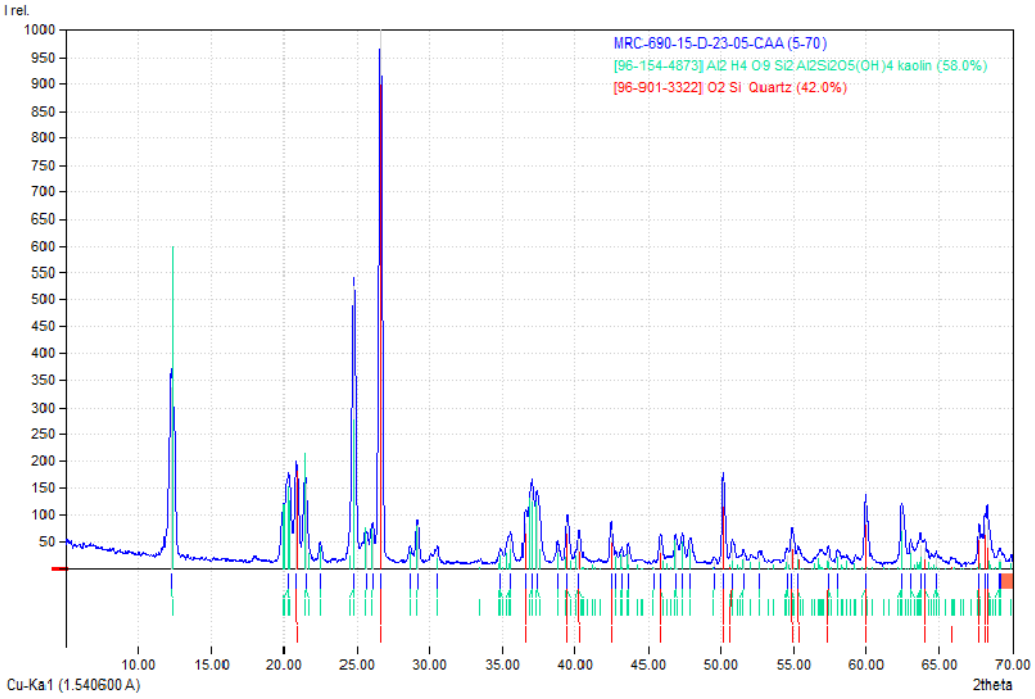
Based on calculated profile

Profile area	*Counts*	*Amount*
Overall diffraction profile	169894	100.00%
Background radiation	62863	37.00%
Diffraction peaks	107031	63.00%
Peak area belonging to selected phases	91874	54.08%
Peak area of phase A (Al2Si2O5(OH)4 kaolin)	*58265*	*34.30%*
Peak area of phase B (Quartz)	*33609*	*19.78%*
Unidentified peak area	15157	8.92%

Peak Residuals

Peak data	*Counts*	*Amount*
Overall peak intensity	3222	100.00%
Peak intensity belonging to selected phases	3165	98.21%
Unidentified peak intensity	58	1.79%

Diffraction Pattern Graphics



LP 10

Match! Phase Analysis Report

Sample: MRC-690-18-12-23-SAA (5-70)

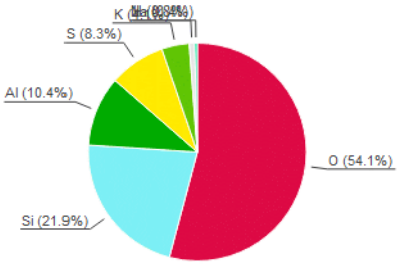
Sample Data

File name	MRC-690-18-12-23-SAA.RAW
File path	D:/FRYAN/XRD AGE/MRC-690-18-12-23-SAA
Data collected	May 9, 2024 20:53:19
Data range	5.000° - 70.000°
Original data range	5.000° - 70.000°
Number of points	3251
Step size	0.020
Rietveld refinement converged	No
Alpha2 subtracted	No
Background subtr.	No
Data smoothed	Yes
Radiation	X-rays
Wavelength	1.540600 Å

Analysis Results

Phase composition (Weight %) calc. by RIR method

Elemental composition (Weight %) calc. by RIR method



Index	*Amount (%)*	*Name*	*Formula sum*
A	46.8	Silicon oxide Quartz	O2 Si
B	53.2	Alunite	Al2.967 H6 K0.805 Na0.132 O14.063 S2
	18.6	*Unidentified peak area*	

Element	*Amount (weight %)*
O	*54.1%(*)*
Si	21.9%
Al	10.4%
S	8.3%
K	4.1%
H	*0.8%(*)*
Na	0.4%
**LE (sum)*	*54.9%*

Details of identified phases

A: Silicon oxide Quartz (46.8 %)

Formula sum	O2 Si
Entry number	96-500-0036
Figure-of-Merit (FoM)	0.930294
Total number of peaks	35
Peaks in range	18
Peaks matched	13
Intensity scale factor	1.44
Space group	P 32 2 1
Crystal system	trigonal (hexagonal axes)
Unit cell	a= 4.9124 Å c= 5.4039 Å
I/Ic	3.26
Calc. density	2.650 g/cm³
Reference	Will G, Bellotto M, Parrish W, Hart M, "Crystal structures of quartz and magnesium germanate by profileanalysis of synchrotron-radiation high-resolution powder data.", Journal of Applied Crystallography **21**, 182-191 (1988)

B: Alunite (53.2 %)

Formula sum	Al2.967 H6 K0.805 Na0.132 O14.063 S2

Entry number	96-901-0878
Figure-of-Merit (FoM)	0.886162
Total number of peaks	102
Peaks in range	49
Peaks matched	30
Intensity scale factor	1.00
Space group	R -3 m
Crystal system	trigonal (hexagonal axes)
Unit cell	a= 6.9741 Å c= 17.1900 Å
I/Ic	2.00
Calc. density	2.819 g/cm³
Reference	Majzlan J., Speziale S., Duffy T. S., Burns P. C., "Single-crystal elastic properties of alunite, KAl3(SO4)2(OH)6", Physics and Chemistry of Minerals **33**, 567-573 (2006)

Search-Match

Settings

Reference database used	COD-Inorg 2024.06.03
Method	Peak-based search-match
Automatic zeropoint adaptation	Yes
Downgrade entries with low scaling factors	Yes
Minimum figure-of-merit (FoM)	0.50
2theta window for peak corr.	0.30 deg.
Minimum rel. int. for peak corr.	1
Parameter/influence 2theta	0.50
Parameter/influence intensities	0.50
Parameter multiple/single phase(s)	0.50

Peak List

No.	*2theta [°]*	*d [Å]*	*I/I0 (peak height)*	*Counts (peak area)*	*FWHM*	*Matched*
1	15.44	5.7343	65.24	39.23	0.5192	B
2	17.98	4.9295	352.24	141.91	0.3479	B
3	20.82	4.2631	207.63	77.47	0.3222	A
4	25.48	3.4930	126.93	46.12	0.3138	B
5	26.62	3.3459	1000.00	330.31	0.2852	A
6	30.04	2.9723	928.79	312.98	0.2910	B
7	31.24	2.8608	116.91	56.71	0.4188	B
8	36.54	2.4571	114.90	37.26	0.2800	A,B
9	39.70	2.2685	378.31	221.46	0.5055	A,B
10	40.30	2.2361	220.23	112.22	0.4400	A
11	42.48	2.1263	73.96	20.96	0.2447	A
12	45.82	1.9788	45.21	13.24	0.2528	A
13	47.90	1.8976	291.70	109.30	0.3236	B
14	50.16	1.8172	176.20	45.50	0.2230	A
15	52.44	1.7435	171.41	46.63	0.2349	B
16	54.88	1.6716	52.17	16.88	0.2794	A,B
17	55.92	1.6429	28.45	11.75	0.3566	B
18	60.02	1.5401	123.92	44.72	0.3117	A
19	62.30	1.4891	169.50	129.40	0.6592	B
20	67.74	1.3822	99.94	43.83	0.3787	A,B
21	68.28	1.3726	109.71	81.34	0.6402	A,B

Integrated Profile Areas

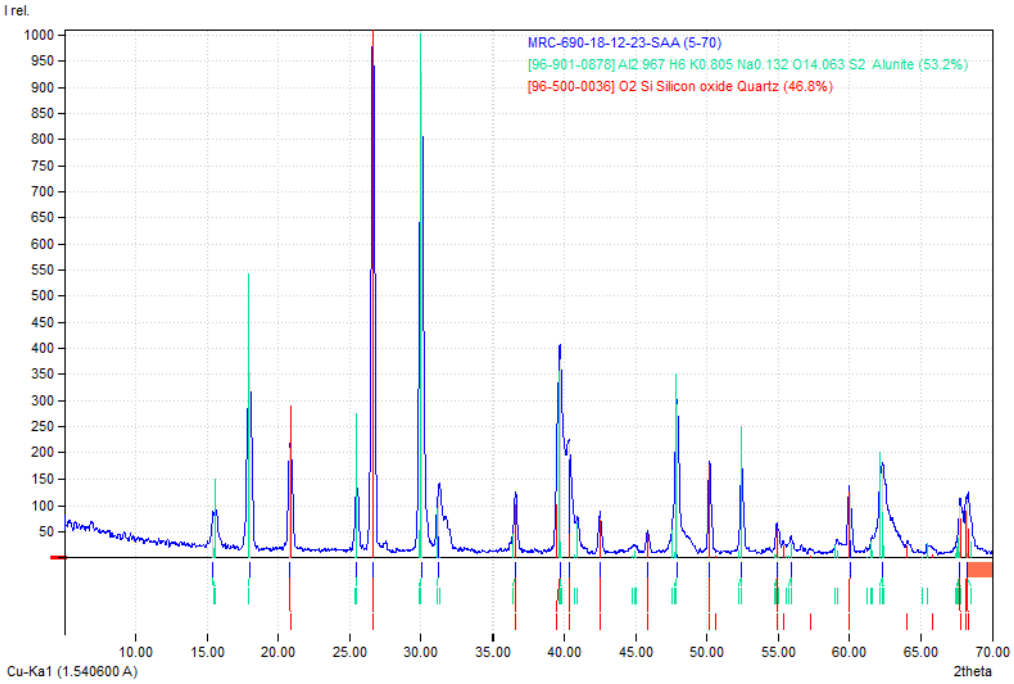
Based on calculated profile

Profile area	***Counts***	***Amount***
Overall diffraction profile	139305	100.00%
Background radiation	49892	35.82%
Diffraction peaks	89413	64.18%
Peak area belonging to selected phases	63506	45.59%
Peak area of phase A (Alunite)	*37482*	*26.91%*
Peak area of phase B (Silicon oxide Quartz)	*26024*	*18.68%*
Unidentified peak area	25907	18.60%

Peak Residuals

Peak data	***Counts***	***Amount***
Overall peak intensity	1939	100.00%
Peak intensity belonging to selected phases	1896	97.78%
Unidentified peak intensity	43	2.22%

Diffraction Pattern Graphics



LP 11

Match! Phase Analysis Report

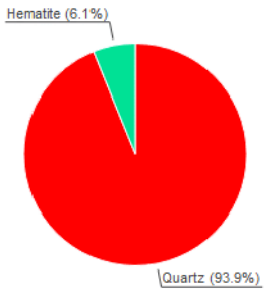
Sample: MRC-690-18-12-23-SM (5-70)

Sample Data

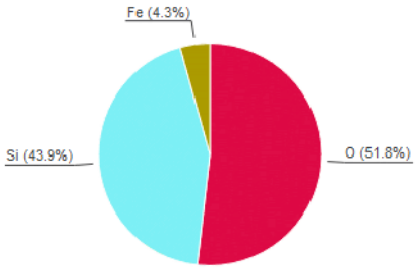
File name	MRC-690-18-12-23-SM.RAW
File path	D:/FRYAN/XRD AGE/MRC-690-18-12-23-SM
Data collected	May 9, 2024 20:53:19
Data range	5.000° - 70.000°
Original data range	5.000° - 70.000°
Number of points	3251
Step size	0.020
Rietveld refinement converged	No
Alpha2 subtracted	No
Background subtr.	No
Data smoothed	Yes
Radiation	X-rays
Wavelength	1.540600 Å

Analysis Results

Phase composition (Weight %) calc. by RIR method



Elemental composition (Weight %) calc. by RIR method



Index	*Amount (%)*	*Name*	*Formula sum*
A	93.9	Quartz	O2 Si
B	6.1	Hematite	Fe2 O3
	13.6	*Unidentified peak area*	

Element	*Amount (weight %)*
O	*51.8%(*)*
Si	43.9%
Fe	4.3%
**LE (sum)*	*51.8%*

Details of identified phases

A: Quartz (93.9 %)

Formula sum	O2 Si
Entry number	96-900-0776
Figure-of-Merit (FoM)	0.969884
Total number of peaks	35
Peaks in range	18
Peaks matched	14
Intensity scale factor	0.90
Space group	P 32 2 1 S
Crystal system	trigonal (hexagonal axes)
Unit cell	a= 4.9160 Å c= 5.4054 Å
I/Ic	3.30
Calc. density	2.646 g/cm³
Reference	Levien L., Prewitt C. T., Weidner D. J., "Structure and elastic properties of quartz at pressureP = 1 atm", American Mineralogist **65**, 920-930 (1980)

B: Hematite (6.1 %)

Formula sum	Fe2 O3
Entry number	96-900-0140
Figure-of-Merit (FoM)	0.651786
Total number of peaks	34

Peaks in range	14
Peaks matched	5
Intensity scale factor	0.07
Space group	R -3 c
Crystal system	trigonal (hexagonal axes)
Unit cell	a= 5.0380 Å c= 13.7720 Å
I/Ic	3.97
Calc. density	5.256 g/cm³
Reference	Blake R. L., Hessevick R. E., Zoltai T., Finger L. W., "Refinement of the hematite structure", American Mineralogist **51**, 123-129 (1966)

Search-Match

Settings

Reference database used	COD-Inorg 2024.06.03
Method	Peak-based search-match
Automatic zeropoint adaptation	Yes
Downgrade entries with low scaling factors	Yes
Minimum figure-of-merit (FoM)	0.50
2theta window for peak corr.	0.30 deg.
Minimum rel. int. for peak corr.	1
Parameter/influence 2theta	0.50
Parameter/influence intensities	0.50
Parameter multiple/single phase(s)	0.50

Peak List

No.	*2theta [°]*	*d [Å]*	*I/I0 (peak height)*	*Counts (peak area)*	*FWHM*	*Matched*
1	20.92	4.2429	158.54	90.52	0.3277	A
2	24.16	3.6808	13.59	10.35	0.4372	B
3	26.68	3.3385	1000.00	428.70	0.2460	A
4	30.04	2.9723	13.29	5.95	0.2570	
5	33.12	2.7026	55.44	38.53	0.3989	B
6	35.74	2.5103	30.53	20.54	0.3861	B
7	36.60	2.4532	88.46	41.26	0.2677	A
8	39.52	2.2784	92.73	37.57	0.2325	A
9	40.32	2.2351	41.81	20.01	0.2746	A
10	42.50	2.1253	61.24	25.18	0.2360	A
11	45.82	1.9788	50.11	18.54	0.2123	A
12	50.18	1.8166	148.24	61.48	0.2380	A
13	54.02	1.6962	25.91	21.23	0.4702	B
14	54.90	1.6710	53.85	21.35	0.2275	A
15	59.98	1.5411	105.25	42.24	0.2303	A
16	64.08	1.4520	32.93	20.72	0.3611	A,B
17	67.76	1.3818	59.98	27.57	0.2638	A
18	68.16	1.3747	77.31	83.85	0.6224	A

Integrated Profile Areas

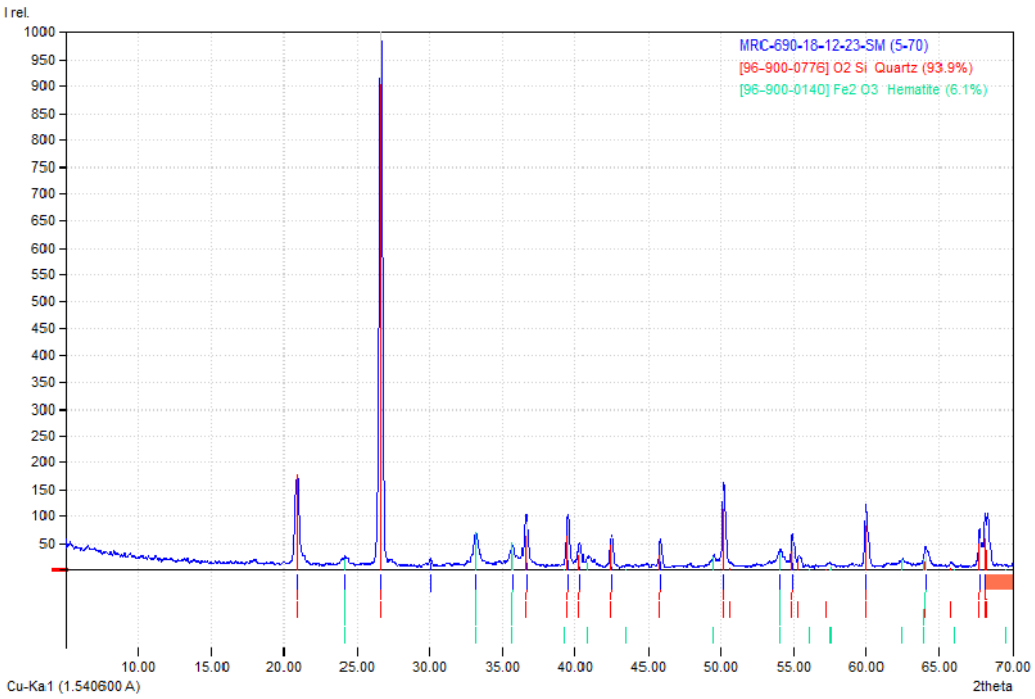
Based on calculated profile

Profile area	***Counts***	***Amount***
Overall diffraction profile	100513	100.00%
Background radiation	49543	49.29%
Diffraction peaks	50971	50.71%
Peak area belonging to selected phases	37312	37.12%
Peak area of phase A (Quartz)	*32473*	*32.31%*
Peak area of phase B (Hematite)	*4839*	*4.81%*
Unidentified peak area	13659	13.59%

Peak Residuals

Peak data	***Counts***	***Amount***
Overall peak intensity	1016	100.00%
Peak intensity belonging to selected phases	995	98.00%
Unidentified peak intensity	20	2.00%

Diffraction Pattern Graphics



LP 31

Match! Phase Analysis Report

Sample: MRC-760-19-24-02 (5-70)

Sample Data

File name	MRC-760-19-24-02.RAW
File path	D:/FRYAN/XRD AGE/MRC-760-19-24-02
Data collected	May 9, 2024 20:53:19
Data range	5.000° - 70.000°
Original data range	5.000° - 70.000°
Number of points	3251
Step size	0.020
Rietveld refinement converged	No
Alpha2 subtracted	No
Background subtr.	No
Data smoothed	Yes
Radiation	X-rays
Wavelength	1.540600 Å

Analysis Results

Phase composition (Weight %) calc. by RIR method

Elemental composition (Weight %) calc. by RIR method

Index	*Amount (%)*	*Name*	*Formula sum*
A	100.0	Quartz	O2 Si
	13.5	*Unidentified peak area*	

Element	*Amount (weight %)*
O	*53.3%(*)*
Si	46.7%
**LE (sum)*	*53.3%*

Details of identified phases

A: Quartz (100.0 %)

Formula sum	O2 Si
Entry number	96-900-0776
Figure-of-Merit (FoM)	0.984195
Total number of peaks	35
Peaks in range	18
Peaks matched	14
Intensity scale factor	1.01
Space group	P 32 2 1 S
Crystal system	trigonal (hexagonal axes)
Unit cell	a= 4.9160 Å c= 5.4054 Å
I/Ic	3.30
Calc. density	2.646 g/cm³
Reference	Levien L., Prewitt C. T., Weidner D. J., "Structure and elastic properties of quartz at pressureP = 1 atm", American Mineralogist **65**, 920-930 (1980)

Search-Match

Settings

Reference database used	COD-Inorg 2024.06.03
Method	Peak-based search-match
Automatic zeropoint adaptation	Yes

Downgrade entries with low scaling factors	Yes
Minimum figure-of-merit (FoM)	0.50
2theta window for peak corr.	0.30 deg.
Minimum rel. int. for peak corr.	1
Parameter/influence 2theta	0.50
Parameter/influence intensities	0.50
Parameter multiple/single phase(s)	0.50

Peak List

No.	*2theta [°]*	*d [Å]*	*I/I0 (peak height)*	*Counts (peak area)*	*FWHM*	*Matched*
1	20.90	4.2469	146.69	146.22	0.3123	A
2	26.70	3.3361	1000.00	775.35	0.2429	A
3	36.60	2.4532	88.14	62.16	0.2210	A
4	39.52	2.2784	79.47	54.08	0.2132	A
5	40.34	2.2340	38.72	27.78	0.2248	A
6	42.52	2.1244	59.68	41.70	0.2189	A
7	45.84	1.9779	39.68	29.69	0.2344	A
8	50.18	1.8166	142.21	110.25	0.2429	A
9	54.90	1.6710	41.42	30.81	0.2331	A
10	59.98	1.5411	96.16	77.92	0.2539	A
11	64.10	1.4516	21.45	18.43	0.2692	A
12	67.76	1.3818	55.65	41.92	0.2360	A
13	68.18	1.3743	72.25	142.41	0.6176	A

Integrated Profile Areas

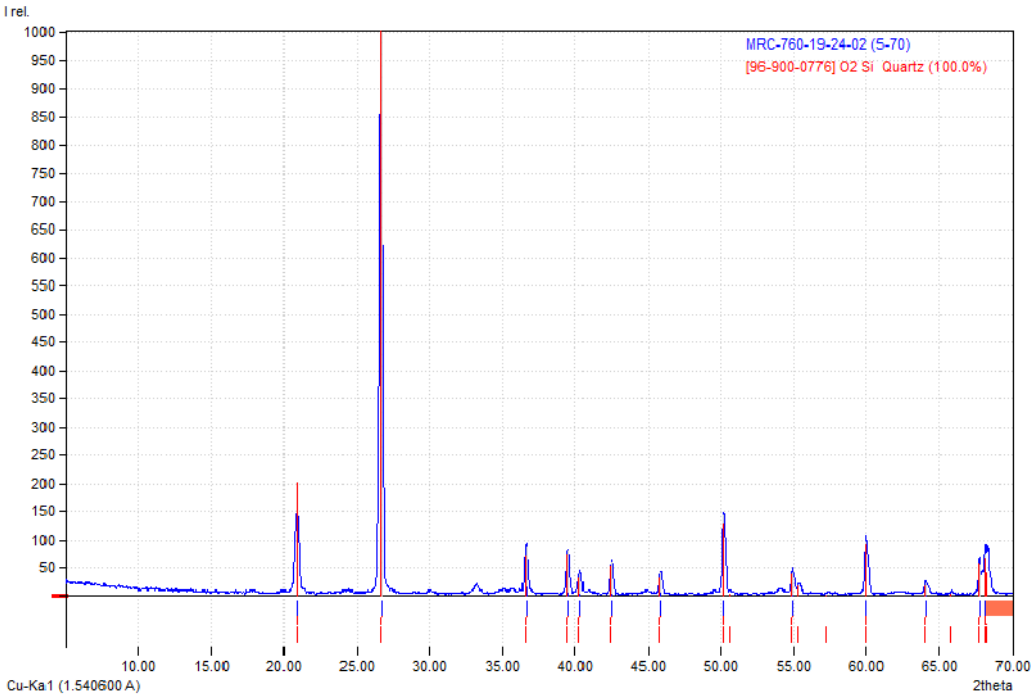
Based on calculated profile

Profile area	*Counts*	*Amount*
Overall diffraction profile	127311	100.00%
Background radiation	51309	40.30%
Diffraction peaks	76002	59.70%
Peak area belonging to selected phases	58816	46.20%
Peak area of phase A (Quartz)	*58816*	*46.20%*
Unidentified peak area	17187	13.50%

Peak Residuals

Peak data	*Counts*	*Amount*
Overall peak intensity	1559	100.00%
Peak intensity belonging to selected phases	1539	98.76%
Unidentified peak intensity	19	1.24%

Diffraction Pattern Graphics



LP 34

Match! Phase Analysis Report

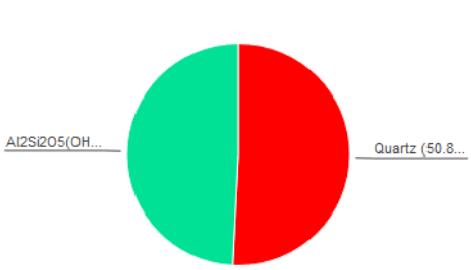
Sample: MRC-760-19-JAN-24-03 (5-70)

Sample Data

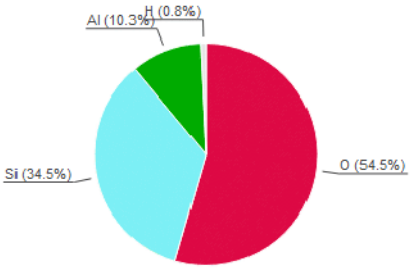
File name	MRC-760-19-JAN-24-03.RAW
File path	D:/FRYAN/XRD AGE/MRC-760-19-JAN-24-03
Data collected	May 9, 2024 20:53:19
Data range	5.000° - 70.000°
Original data range	5.000° - 70.000°
Number of points	3251
Step size	0.020
Rietveld refinement converged	No
Alpha2 subtracted	No
Background subtr.	No
Data smoothed	Yes
Radiation	X-rays
Wavelength	1.540600 Å

Analysis Results

Phase composition (Weight %) calc. by RIR method



Elemental composition (Weight %) calc. by RIR method



Index	*Amount (%)*	*Name*	*Formula sum*
A	50.8	Quartz	O2 Si
B	49.2	Al2Si2O5(OH)4 kaolin	Al2 H4 O9 Si2
	16.6	*Unidentified peak area*	

Element	*Amount (weight %)*
O	*54.5%(*)*
Si	34.5%
Al	10.3%
H	*0.8%(*)*
**LE (sum)*	*55.3%*

Details of identified phases

A: Quartz (50.8 %)

Formula sum	O2 Si
Entry number	96-900-5018
Figure-of-Merit (FoM)	0.890669
Total number of peaks	35
Peaks in range	18
Peaks matched	15
Intensity scale factor	1.00
Space group	P 32 2 1 S
Crystal system	trigonal (hexagonal axes)
Unit cell	a= 4.9137 Å c= 5.4047 Å
I/Ic	3.31
Calc. density	2.649 g/cm³
Reference	Kihara K., "An X-ray study of the temperature dependence of the quartz structureSample: at T = 298 K", European Journal of Mineralogy **2**, 63-77 (1990)

B: Al2Si2O5(OH)4 kaolin (49.2 %)

Formula sum	Al2 H4 O9 Si2
Entry number	96-154-4873
Figure-of-Merit (FoM)	0.734886

Total number of peaks	289
Peaks in range	135
Peaks matched	51
Intensity scale factor	0.47
Space group	C 1 c 1
Crystal system	monoclinic
Unit cell	a= 8.9200 Å b= 5.1570 Å c= 15.6840 Å β= 113.610 °
I/Ic	1.60
Calc. density	2.553 g/cm³
Reference	Toraya H., Iwai S., Marumo F., "The structural investigation of a kaolin mineral by X-ray powderpattern-fitting", Mineralogical Journal **10**, 168-180 (1980)

Search-Match

Settings

Reference database used	COD-Inorg 2024.06.03
Method	Peak-based search-match
Automatic zeropoint adaptation	Yes
Downgrade entries with low scaling factors	Yes
Minimum figure-of-merit (FoM)	0.50
2theta window for peak corr.	0.30 deg.
Minimum rel. int. for peak corr.	1
Parameter/influence 2theta	0.50
Parameter/influence intensities	0.50
Parameter multiple/single phase(s)	0.50

Criteria for entries added by user

Reference:

Entry number: 96-101-1046;96-154-4873;96-155-0599;96-900-9231;96-900-9235;96-901-5000;96-900-1665;96-900-3815;96-900-4787;96-900-4919;96-900-7429;96-900-7612;96-900-9523;96-900-9666;96-901-0118;96-901-0494;96-901-0549;96-901-1123;96-901-1745;96-901-1746;96-901-2893;96-901-3719;96-901-3720;96-901-3721;96-901-3722;96-901-3723;96-901-3724;96-901-3733;96-901-3985;96-901-4065;96-901-6664

Peak List

No.	*2theta [°]*	*d [Å]*	*I/I0 (peak height)*	*Counts (peak area)*	*FWHM*	*Matched*
1	12.28	7.2019	298.17	134.84	0.4594	B
2	19.90	4.4580	88.33	70.87	0.8150	B
3	20.34	4.3626	158.34	218.24	1.4000	B
4	20.82	4.2631	200.95	99.77	0.5043	A
5	24.92	3.5702	454.36	135.72	0.3034	B
6	26.66	3.3410	1000.00	240.68	0.2445	A
7	29.10	3.0662	42.69	12.09	0.2876	B
8	33.16	2.6995	53.06	20.99	0.4018	B
9	35.04	2.5588	118.84	49.58	0.4238	B
10	35.94	2.4968	83.59	52.86	0.6423	
11	36.62	2.4519	80.18	28.71	0.3637	A,B
12	37.76	2.3805	53.50	13.72	0.2605	B
13	38.50	2.3364	143.03	50.54	0.3589	
14	39.28	2.2918	92.48	39.09	0.4294	A,B
15	40.22	2.2404	43.96	12.13	0.2804	A,B
16	42.46	2.1272	76.09	15.46	0.2063	A,B
17	45.10	2.0087	43.86	19.90	0.4609	B
18	45.80	1.9796	62.38	25.14	0.4094	A,B
19	50.14	1.8179	143.94	32.30	0.2279	A,B
20	54.34	1.6869	37.41	14.65	0.3978	B
21	55.08	1.6660	85.94	19.29	0.2279	A,B
22	56.80	1.6196	28.25	15.52	0.5579	B
23	59.96	1.5415	127.23	39.02	0.3115	A,B
24	62.32	1.4887	84.59	32.32	0.3881	B
25	64.06	1.4524	37.71	13.77	0.3710	A,B
26	67.74	1.3822	45.89	31.92	0.7065	A,B
27	68.30	1.3722	61.76	46.27	0.7610	A,B

Integrated Profile Areas

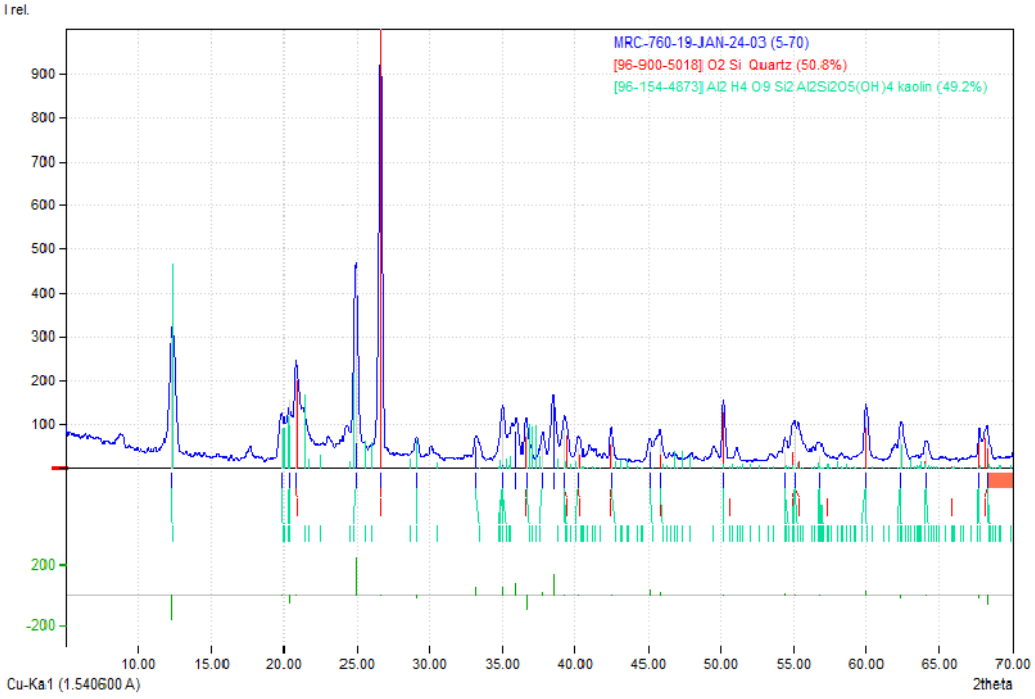
Based on calculated profile

Profile area	***Counts***	***Amount***
Overall diffraction profile	140508	100.00%
Background radiation	77674	55.28%
Diffraction peaks	62834	44.72%
Peak area belonging to selected phases	39452	28.08%
Peak area of phase A (Quartz)	*19839*	*14.12%*
Peak area of phase B (Al2Si2O5(OH)4 kaolin)	*19613*	*13.96%*
Unidentified peak area	23382	16.64%

Peak Residuals

Peak data	*Counts*	*Amount*
Overall peak intensity	1485	100.00%
Peak intensity belonging to selected phases	1430	96.27%
Unidentified peak intensity	55	3.73%

Diffraction Pattern Graphics



LP 38

Match! Phase Analysis Report

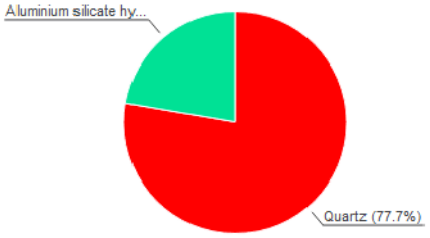
Sample: MRC-760-17-JAN-24-05 (5-70)

Sample Data

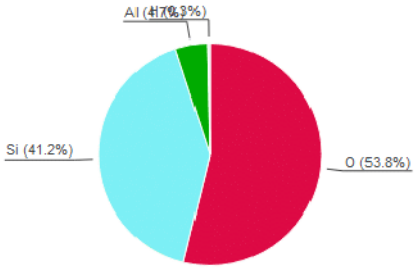
File name	MRC-760-17-JAN-24-05.RAW
File path	D:/FRYAN/XRD AGE/MRC-760-17-JAN-24-05
Data collected	May 9, 2024 20:53:19
Data range	5.000° - 70.000°
Original data range	5.000° - 70.000°
Number of points	3251
Step size	0.020
Rietveld refinement converged	No
Alpha2 subtracted	No
Background subtr.	No
Data smoothed	Yes
Radiation	X-rays
Wavelength	1.540600 Å

Analysis Results

Phase composition (Weight %) calc. by RIR method



Elemental composition (Weight %) calc. by RIR method



Index	*Amount (%)*	*Name*	*Formula sum*
A	77.7	Quartz	O2 Si
B	22.3	Aluminium silicate hydroxide * Metahalloysite	Al2 H4 O9 Si2
	13.3	*Unidentified peak area*	

Element	*Amount (weight %)*
O	*53.8%(*)*
Si	41.2%
Al	4.7%
H	*0.3%(*)*
*LE (sum)	*54.2%*

Details of identified phases

A: Quartz (77.7 %)

Formula sum	O2 Si
Entry number	96-900-0776
Figure-of-Merit (FoM)	0.952774
Total number of peaks	35
Peaks in range	18
Peaks matched	14
Intensity scale factor	1.01
Space group	P 32 2 1 S
Crystal system	trigonal (hexagonal axes)
Unit cell	a= 4.9160 Å c= 5.4054 Å
I/Ic	3.30
Calc. density	2.646 g/cm³
Reference	Levien L., Prewitt C. T., Weidner D. J., "Structure and elastic properties of quartz at pressureP = 1 atm", American Mineralogist **65**, 920-930 (1980)

B: Aluminium silicate hydroxide * Metahalloysite (22.3 %)

Formula sum	Al2 H4 O9 Si2
Entry number	96-101-1248

Figure-of-Merit (FoM)	0.633237
Total number of peaks	196
Peaks in range	78
Peaks matched	17
Intensity scale factor	0.16
Space group	C 1 m 1
Crystal system	monoclinic
Unit cell	a= 5.1500 Å b= 8.9000 Å c= 7.5700 Å β= 100.000 °
I/Ic	1.79
Calc. density	2.469 g/cm³
Reference	Mehmel M, "Ueber die Struktur von Halloysit und Metahalloysit.", Zeitschrift fuer Kristallographie, Kristallgeometrie, Kristallphysik,Kristallchemie (-144,1977) **90**, 35-43 (1935)

Search-Match

Settings

Reference database used	COD-Inorg 2024.06.03
Method	Peak-based search-match
Automatic zeropoint adaptation	Yes
Downgrade entries with low scaling factors	Yes
Minimum figure-of-merit (FoM)	0.50
2theta window for peak corr.	0.30 deg.
Minimum rel. int. for peak corr.	1
Parameter/influence 2theta	0.50
Parameter/influence intensities	0.50
Parameter multiple/single phase(s)	0.50

Peak List

No.	*2theta [°]*	*d [Å]*	*I/I0 (peak height)*	*Counts (peak area)*	*FWHM*	*Matched*
1	19.90	4.4580	115.35	63.86	0.4738	B
2	20.84	4.2590	186.05	94.68	0.4356	A
3	26.68	3.3385	1000.00	291.52	0.2495	A
4	33.32	2.6869	34.52	12.65	0.3138	
5	35.06	2.5574	91.66	76.71	0.7164	B
6	36.64	2.4507	108.50	51.70	0.4079	A
7	39.50	2.2796	75.54	17.76	0.2013	A,B
8	40.30	2.2361	43.96	13.58	0.2643	A
9	42.48	2.1263	79.09	19.68	0.2130	A,B
10	45.80	1.9796	44.60	13.15	0.2524	A
11	50.16	1.8172	155.55	41.62	0.2290	A,B
12	53.30	1.7174	23.41	6.29	0.2301	B
13	54.36	1.6863	22.45	9.56	0.3646	B
14	54.86	1.6721	50.72	17.06	0.2880	A,B
15	59.28	1.5576	18.39	7.62	0.3544	
16	59.96	1.5415	109.76	36.24	0.2826	A,B
17	62.16	1.4922	54.20	39.14	0.6181	B
18	64.06	1.4524	34.22	11.71	0.2929	A,B
19	67.76	1.3818	63.77	27.70	0.3718	A
20	68.14	1.3750	72.60	64.05	0.7551	A,B

Integrated Profile Areas

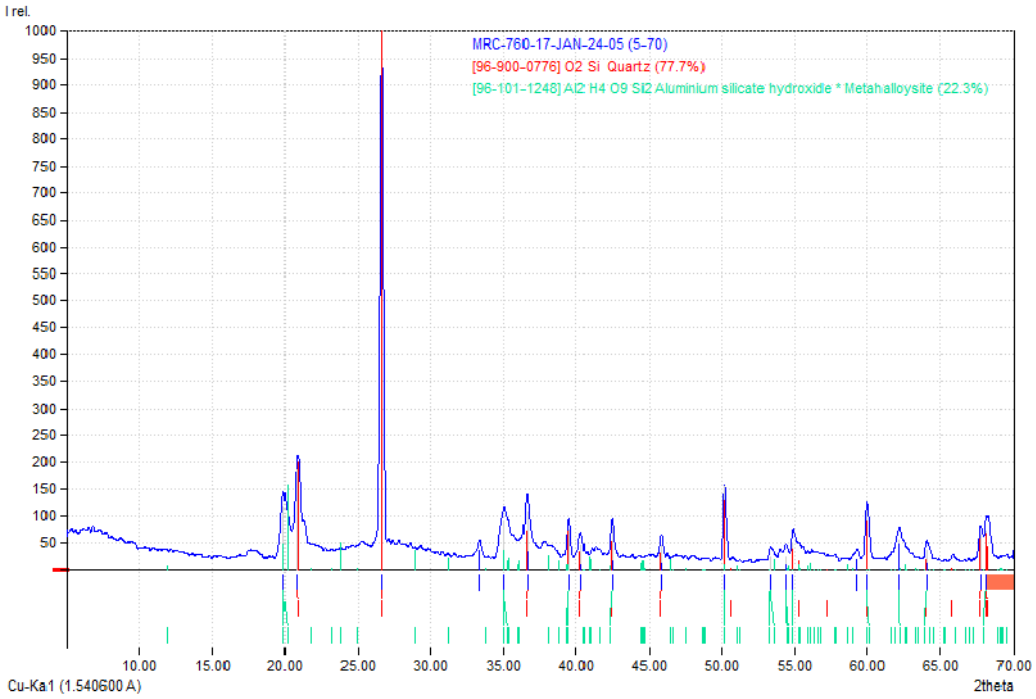
Based on calculated profile

Profile area	***Counts***	***Amount***
Overall diffraction profile	132609	100.00%
Background radiation	86124	64.95%
Diffraction peaks	46485	35.05%
Peak area belonging to selected phases	28864	21.77%
Peak area of phase A (Quartz)	*22709*	*17.12%*
*Peak area of phase B (Aluminium silicate hydroxide * Metahalloysite)*	*6155*	*4.64%*
Unidentified peak area	17621	13.29%

Peak Residuals

Peak data	***Counts***	***Amount***
Overall peak intensity	916	100.00%
Peak intensity belonging to selected phases	875	95.50%
Unidentified peak intensity	41	4.50%

Diffraction Pattern Graphics



LP 42

Match! Phase Analysis Report

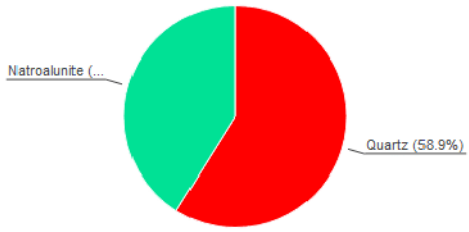
Sample: MRC-725-2-JAN-24-06 (5-70)

Sample Data

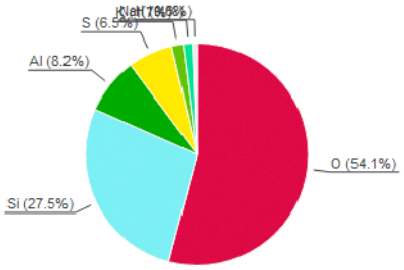
File name	MRC-725-2-JAN-24-06.RAW
File path	D:/FRYAN/XRD AGE/MRC-725-2-JAN-24-06
Data collected	May 9, 2024 20:53:19
Data range	5.000° - 70.000°
Original data range	5.000° - 70.000°
Number of points	3251
Step size	0.020
Rietveld refinement converged	No
Alpha2 subtracted	No
Background subtr.	No
Data smoothed	Yes
Radiation	X-rays
Wavelength	1.540600 Å

Analysis Results

Phase composition (Weight %) calc. by RIR method



Elemental composition (Weight %) calc. by RIR method



Index	*Amount (%)*	*Name*	*Formula sum*
A	58.9	Quartz	O2 Si
B	41.1	Natroalunite	Al3 H6 K0.42 Na0.58 O14 S2
	18.8	*Unidentified peak area*	

Element	*Amount (weight %)*
O	*54.1%(*)*
Si	27.5%
Al	8.2%
S	6.5%
K	1.7%
Na	1.4%
H	*0.6%(*)*
**LE (sum)*	*54.7%*

Details of identified phases

A: Quartz (58.9 %)

Formula sum	O2 Si
Entry number	96-901-2601
Figure-of-Merit (FoM)	0.936816
Total number of peaks	35
Peaks in range	18
Peaks matched	15
Intensity scale factor	1.08
Space group	P 31 2 1
Crystal system	trigonal (hexagonal axes)
Unit cell	a= 4.9140 Å c= 5.4060 Å
I/Ic	3.32
Calc. density	2.648 g/cm³
Reference	Hazen R. M., Finger L. W., Hemley R. J., Mao H. K., "High-pressure crystal chemistry and amorphization of alpha-quartzSample: P = 1 bar", Solid State Communications **72**, 507-511 (1989)

B: Natroalunite (41.1 %)

Formula sum	Al3 H6 K0.42 Na0.58 O14 S2
Entry number	96-900-9298
Figure-of-Merit (FoM)	0.829151
Total number of peaks	100
Peaks in range	48
Peaks matched	29
Intensity scale factor	0.41
Space group	R -3 m
Crystal system	trigonal (hexagonal axes)
Unit cell	a= 6.9900 Å c= 16.9050 Å
I/Ic	1.82
Calc. density	2.820 g/cm³
Reference	Okada K., Hirabayashi J., Ossaka J., "Crystal structure of natroalunite and crystal chemistry of the alunite group", Neues Jahrbuch fur Mineralogie, Monatshefte **1982**, 534-540 (1982)

Search-Match

Settings

Reference database used	COD-Inorg 2024.06.03
Method	Peak-based search-match
Automatic zeropoint adaptation	Yes
Downgrade entries with low scaling factors	Yes
Minimum figure-of-merit (FoM)	0.50
2theta window for peak corr.	0.30 deg.
Minimum rel. int. for peak corr.	1
Parameter/influence 2theta	0.50
Parameter/influence intensities	0.50
Parameter multiple/single phase(s)	0.50

Peak List

No.	*2theta [°]*	*d [Å]*	*I/I0 (peak height)*	*Counts (peak area)*	*FWHM*	*Matched*
1	15.70	5.6399	42.31	29.31	0.4325	B
2	18.02	4.9187	171.41	97.02	0.3532	B
3	20.82	4.2631	164.01	84.98	0.3234	A
4	25.56	3.4822	71.74	31.91	0.2776	B
5	26.66	3.3410	1000.00	394.18	0.2460	A
6	30.12	2.9646	454.34	214.86	0.2951	B
7	31.92	2.8014	104.56	61.53	0.3673	B
8	33.16	2.6995	16.27	12.50	0.4796	
9	36.58	2.4545	117.23	45.85	0.2441	A,B
10	39.54	2.2773	93.71	55.15	0.3674	A
11	40.36	2.2329	262.63	162.21	0.3855	A,B
12	42.48	2.1263	68.81	22.35	0.2027	A
13	45.82	1.9788	50.73	16.59	0.2042	A
14	47.98	1.8946	147.09	60.60	0.2572	B
15	48.68	1.8690	65.87	51.26	0.4857	B
16	50.16	1.8172	163.92	57.95	0.2207	A
17	52.44	1.7435	103.46	36.07	0.2176	B
18	54.88	1.6716	40.55	14.91	0.2295	A,B
19	55.36	1.6582	16.69	7.83	0.2927	A,B
20	55.90	1.6435	15.14	6.24	0.2573	B
21	59.98	1.5411	109.62	52.25	0.2975	A
22	62.68	1.4810	48.17	55.57	0.7200	B
23	63.22	1.4697	66.61	79.51	0.7450	
24	64.00	1.4536	22.05	26.31	0.7450	A
25	67.74	1.3822	74.49	27.75	0.2325	A,B
26	68.32	1.3718	96.28	94.43	0.6121	A,B

Integrated Profile Areas

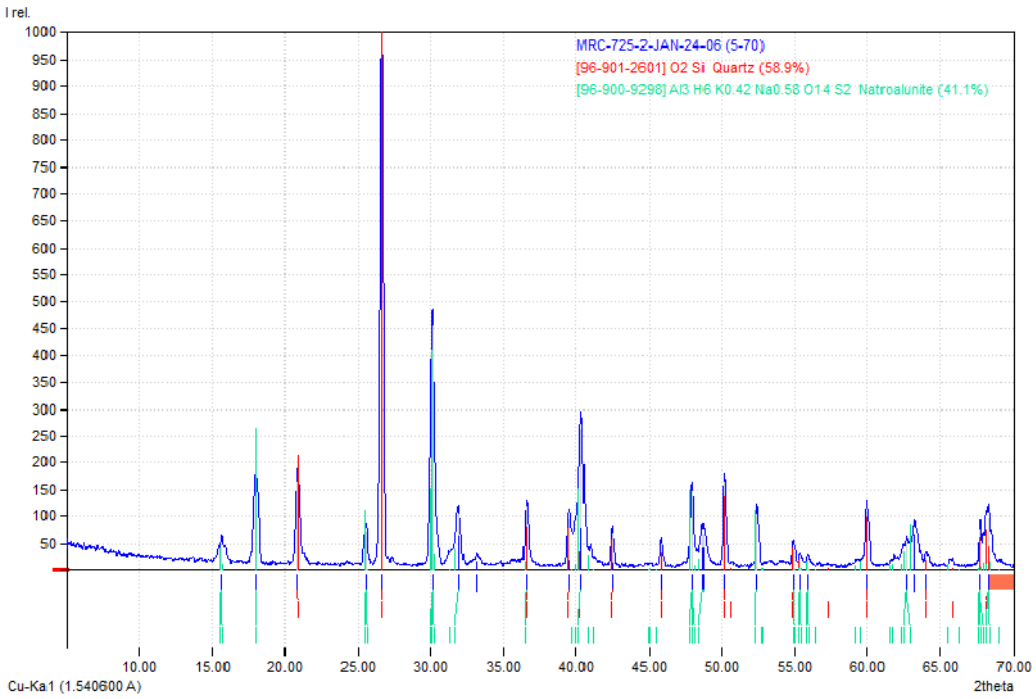
Based on calculated profile

Profile area	***Counts***	***Amount***
Overall diffraction profile	134556	100.00%
Background radiation	52110	38.73%
Diffraction peaks	82446	61.27%
Peak area belonging to selected phases	57143	42.47%
Peak area of phase A (Quartz)	*31531*	*23.43%*
Peak area of phase B (Natroalunite)	*25613*	*19.03%*
Unidentified peak area	25303	18.80%

Peak Residuals

Peak data	***Counts***	***Amount***
Overall peak intensity	1799	100.00%
Peak intensity belonging to selected phases	1718	95.49%
Unidentified peak intensity	81	4.51%

Diffraction Pattern Graphics



LP 43

Match! Phase Analysis Report

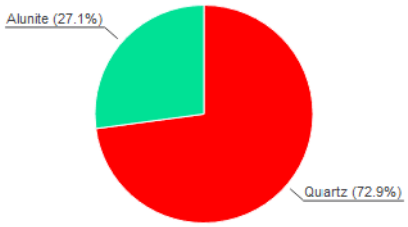
Sample: MRC-725-2-1-24 (5-70)

Sample Data

File name	MRC-725-2-1-24.RAW
File path	D:/FRYAN/XRD AGE/MRC-725-2-1-24
Data collected	May 9, 2024 20:53:19
Data range	5.000° - 70.000°
Original data range	5.000° - 70.000°
Number of points	3251
Step size	0.020
Rietveld refinement converged	No
Alpha2 subtracted	No
Background subtr.	No
Data smoothed	Yes
Radiation	X-rays
Wavelength	1.540600 Å

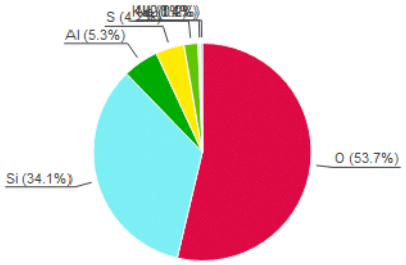
Analysis Results

Phase composition (Weight %) calc. by RIR method



Index	*Amount (%)*	*Name*	*Formula sum*
A	72.9	Quartz	O2 Si
B	27.1	Alunite	Al2.967 H6 K0.805 Na0.132 O14.063 S2
	16.7	*Unidentified peak area*	

Elemental composition (Weight %) calc. by RIR method



Element	*Amount (weight %)*
O	*53.7%(*)*
Si	34.1%
Al	5.3%
S	4.2%
K	2.1%
H	0.4%(*)
Na	0.2%
**LE (sum)*	*54.1%*

Details of identified phases

A: Quartz (72.9 %)

Formula sum	O2 Si
Entry number	96-900-0776
Figure-of-Merit (FoM)	0.957410
Total number of peaks	35
Peaks in range	18
Peaks matched	14
Intensity scale factor	1.00
Space group	P 32 2 1 S
Crystal system	trigonal (hexagonal axes)
Unit cell	a= 4.9160 Å c= 5.4054 Å
I/Ic	3.30
Calc. density	2.646 g/cm³
Reference	Levien L., Prewitt C. T., Weidner D. J., "Structure and elastic properties of quartz at pressureP = 1 atm", American Mineralogist **65**, 920-930 (1980)

B: Alunite (27.1 %)

Formula sum	Al2.967 H6 K0.805 Na0.132 O14.063 S2

Entry number	96-901-0878
Figure-of-Merit (FoM)	0.836481
Total number of peaks	102
Peaks in range	49
Peaks matched	28
Intensity scale factor	0.23
Space group	R -3 m
Crystal system	trigonal (hexagonal axes)
Unit cell	a= 6.9741 Å c= 17.1900 Å
I/Ic	2.00
Calc. density	2.819 g/cm³
Reference	Majzlan J., Speziale S., Duffy T. S., Burns P. C., "Single-crystal elastic properties of alunite, KAl3(SO4)2(OH)6", Physics and Chemistry of Minerals **33**, 567-573 (2006)

Search-Match

Settings

Reference database used	COD-Inorg 2024.06.03
Method	Peak-based search-match
Automatic zeropoint adaptation	Yes
Downgrade entries with low scaling factors	Yes
Minimum figure-of-merit (FoM)	0.50
2theta window for peak corr.	0.30 deg.
Minimum rel. int. for peak corr.	1
Parameter/influence 2theta	0.50
Parameter/influence intensities	0.50
Parameter multiple/single phase(s)	0.50

Peak List

No.	*2theta [°]*	*d [Å]*	*I/I0 (peak height)*	*Counts (peak area)*	*FWHM*	*Matched*
1	15.54	5.6976	21.80	24.36	0.4572	B
2	18.02	4.9187	98.56	82.78	0.3437	B
3	20.90	4.2469	170.55	123.89	0.2973	A
4	25.50	3.4903	43.31	28.66	0.2708	B
5	26.66	3.3410	1000.00	583.85	0.2389	A
6	30.06	2.9704	266.77	183.62	0.2817	B
7	31.26	2.8591	18.62	18.99	0.4173	B
8	36.58	2.4545	110.02	63.01	0.2344	A,B
9	39.56	2.2762	114.94	103.25	0.3676	A,B
10	40.32	2.2351	58.54	113.55	0.7937	A
11	42.48	2.1263	85.70	42.55	0.2032	A
12	45.82	1.9788	43.70	23.80	0.2229	A
13	47.94	1.8961	83.15	58.97	0.2902	B
14	50.18	1.8166	154.32	83.95	0.2226	A
15	52.46	1.7429	57.14	32.12	0.2300	B
16	54.90	1.6710	45.47	27.37	0.2463	A,B
17	59.98	1.5411	107.65	70.47	0.2679	A
18	62.34	1.4883	32.26	57.75	0.7325	B
19	64.06	1.4524	17.13	15.75	0.3762	A
20	67.76	1.3818	70.80	47.35	0.2737	A,B
21	68.32	1.3718	87.68	106.38	0.4965	A,B

Integrated Profile Areas

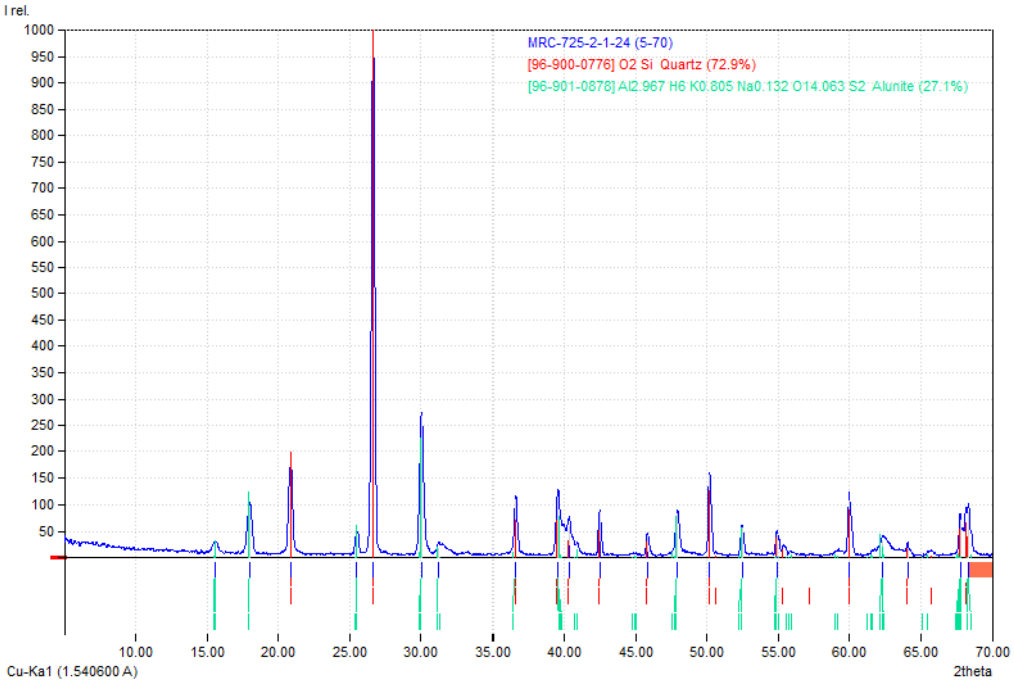
Based on calculated profile

Profile area	***Counts***	***Amount***
Overall diffraction profile	140794	100.00%
Background radiation	51822	36.81%
Diffraction peaks	88972	63.19%
Peak area belonging to selected phases	65460	46.49%
Peak area of phase A (Quartz)	*44653*	*31.72%*
Peak area of phase B (Alunite)	*20807*	*14.78%*
Unidentified peak area	23512	16.70%

Peak Residuals

Peak data	***Counts***	***Amount***
Overall peak intensity	1892	100.00%
Peak intensity belonging to selected phases	1856	98.10%
Unidentified peak intensity	36	1.90%

Diffraction Pattern Graphics



LP 47

Match! Phase Analysis Report

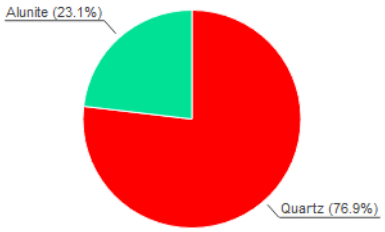
Sample: MRC-710-6-JAN-24-02 (5-70)

Sample Data

File name	MRC-710-6-JAN-24-02.RAW
File path	D:/FRYAN/XRD AGE/MRC-710-6-JAN-24-02
Data collected	May 9, 2024 20:53:19
Data range	5.000° - 70.000°
Original data range	5.000° - 70.000°
Number of points	3251
Step size	0.020
Rietveld refinement converged	No
Alpha2 subtracted	No
Background subtr.	No
Data smoothed	Yes
Radiation	X-rays
Wavelength	1.540600 Å

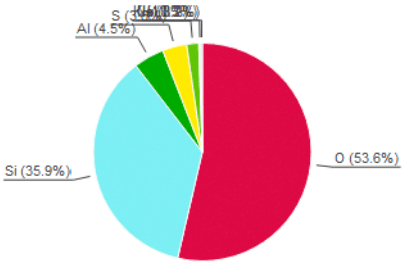
Analysis Results

Phase composition (Weight %) calc. by RIR method



Index	*Amount (%)*	*Name*	*Formula sum*
A	76.9	Quartz	O2 Si
B	23.1	Alunite	Al2.967 H6 K0.805 Na0.132 O14.063 S2
	11.6	*Unidentified peak area*	

Elemental composition (Weight %) calc. by RIR method



Element	*Amount (weight %)*
O	*53.6%(*)*
Si	35.9%
Al	4.5%
S	3.6%
K	1.8%
H	0.3%(*)
Na	0.2%
**LE (sum)*	*54.0%*

Details of identified phases

A: Quartz (76.9 %)

Formula sum	O2 Si
Entry number	96-900-5018
Figure-of-Merit (FoM)	0.958562
Total number of peaks	35
Peaks in range	18
Peaks matched	15
Intensity scale factor	1.34
Space group	P 32 2 1 S
Crystal system	trigonal (hexagonal axes)
Unit cell	a= 4.9137 Å c= 5.4047 Å
I/Ic	3.31
Calc. density	2.649 g/cm³
Reference	Kihara K., "An X-ray study of the temperature dependence of the quartz structureSample: at T = 298 K", European Journal of Mineralogy **2**, 63-77 (1990)

B: Alunite (23.1 %)

Formula sum	Al2.967 H6 K0.805 Na0.132 O14.063 S2

Entry number	96-901-0878
Figure-of-Merit (FoM)	0.812416
Total number of peaks	102
Peaks in range	49
Peaks matched	29
Intensity scale factor	0.24
Space group	R -3 m
Crystal system	trigonal (hexagonal axes)
Unit cell	a= 6.9741 Å c= 17.1900 Å
I/Ic	2.00
Calc. density	2.819 g/cm³
Reference	Majzlan J., Speziale S., Duffy T. S., Burns P. C., "Single-crystal elastic properties of alunite, KAl3(SO4)2(OH)6", Physics and Chemistry of Minerals **33**, 567-573 (2006)

Search-Match

Settings

Reference database used	COD-Inorg 2024.06.03
Method	Peak-based search-match
Automatic zeropoint adaptation	Yes
Downgrade entries with low scaling factors	Yes
Minimum figure-of-merit (FoM)	0.50
2theta window for peak corr.	0.30 deg.
Minimum rel. int. for peak corr.	1
Parameter/influence 2theta	0.50
Parameter/influence intensities	0.50
Parameter multiple/single phase(s)	0.50

Peak List

No.	*2theta [°]*	*d [Å]*	*I/I0 (peak height)*	*Counts (peak area)*	*FWHM*	*Matched*
1	15.48	5.7196	19.38	16.11	0.3180	B
2	17.86	4.9624	61.16	55.01	0.3442	B
3	20.86	4.2550	167.32	128.03	0.2928	A
4	25.50	3.4903	39.11	27.63	0.2703	B
5	26.68	3.3385	1000.00	662.46	0.2535	A
6	29.96	2.9801	211.80	145.93	0.2636	B
7	31.20	2.8644	39.38	36.39	0.3537	B
8	36.58	2.4545	92.92	60.43	0.2489	A,B
9	39.52	2.2784	193.73	130.12	0.2570	A,B
10	40.32	2.2351	44.24	29.97	0.2592	A
11	42.48	2.1263	76.10	41.81	0.2102	A
12	45.82	1.9788	44.04	24.70	0.2146	A
13	47.86	1.8991	68.42	52.06	0.2911	B
14	50.18	1.8166	162.07	95.63	0.2258	A
15	52.44	1.7435	49.13	28.82	0.2244	B
16	54.88	1.6716	41.58	30.65	0.2820	A,B
17	55.36	1.6582	19.49	12.42	0.2438	A,B
18	59.96	1.5415	115.75	71.11	0.2351	A
19	62.00	1.4956	39.52	64.46	0.6241	B
20	64.06	1.4524	20.03	13.38	0.2556	A
21	67.76	1.3818	66.48	64.82	0.3731	A,B
22	68.34	1.3715	90.65	125.47	0.5297	A,B

Integrated Profile Areas

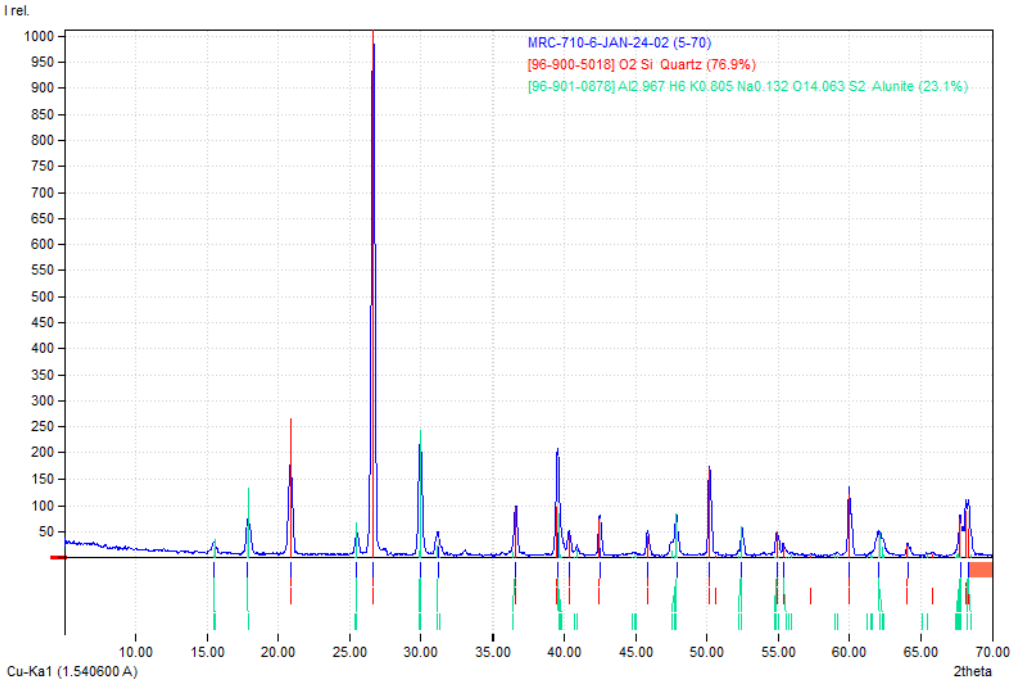
Based on calculated profile

Profile area	***Counts***	***Amount***
Overall diffraction profile	138159	100.00%
Background radiation	48820	35.34%
Diffraction peaks	89339	64.66%
Peak area belonging to selected phases	73249	53.02%
Peak area of phase A (Quartz)	*52587*	*38.06%*
Peak area of phase B (Alunite)	*20662*	*14.96%*
Unidentified peak area	16090	11.65%

Peak Residuals

Peak data	***Counts***	***Amount***
Overall peak intensity	1917	100.00%
Peak intensity belonging to selected phases	1886	98.34%
Unidentified peak intensity	32	1.66%

Diffraction Pattern Graphics



LP 52

Match! Phase Analysis Report

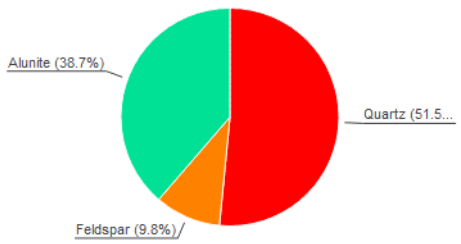
Sample: MRC-695-28124-SAA-JARO (5-70)

Sample Data

File name	MRC-695-28-JAN-24-SAA-JARO.RAW
File path	D:/FRYAN/XRD AGE/MRC-695-28-JAN-24-SAA-JARO
Data collected	May 9, 2024 20:53:19
Data range	5.000° - 70.000°
Original data range	5.000° - 70.000°
Number of points	3251
Step size	0.020
Rietveld refinement converged	No
Alpha2 subtracted	No
Background subtr.	No
Data smoothed	Yes
Radiation	X-rays
Wavelength	1.540600 Å

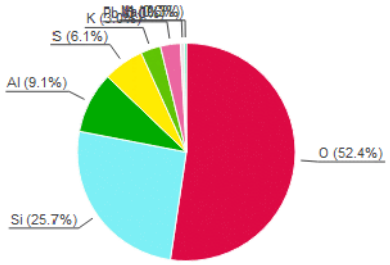
Analysis Results

Phase composition (Weight %) calc. by RIR method



Index	*Amount (%)*	*Name*	*Formula sum*
A	51.5	Quartz	O2 Si
B	9.8	Feldspar	Al2 O8 Pb0.5 Si2
C	38.7	Alunite	Al2.967 H6 K0.805 Na0.132 O14.063 S2
	19.4	*Unidentified peak area*	

Elemental composition (Weight %) calc. by RIR method



Element	*Amount (weight %)*
O	*52.4%(*)*
Si	25.7%
Al	9.1%
S	6.1%
K	3.0%
Pb	3.0%
H	0.6%(*)
Na	0.3%
**LE (sum)*	*52.9%*

Details of identified phases

A: Quartz (51.5 %)

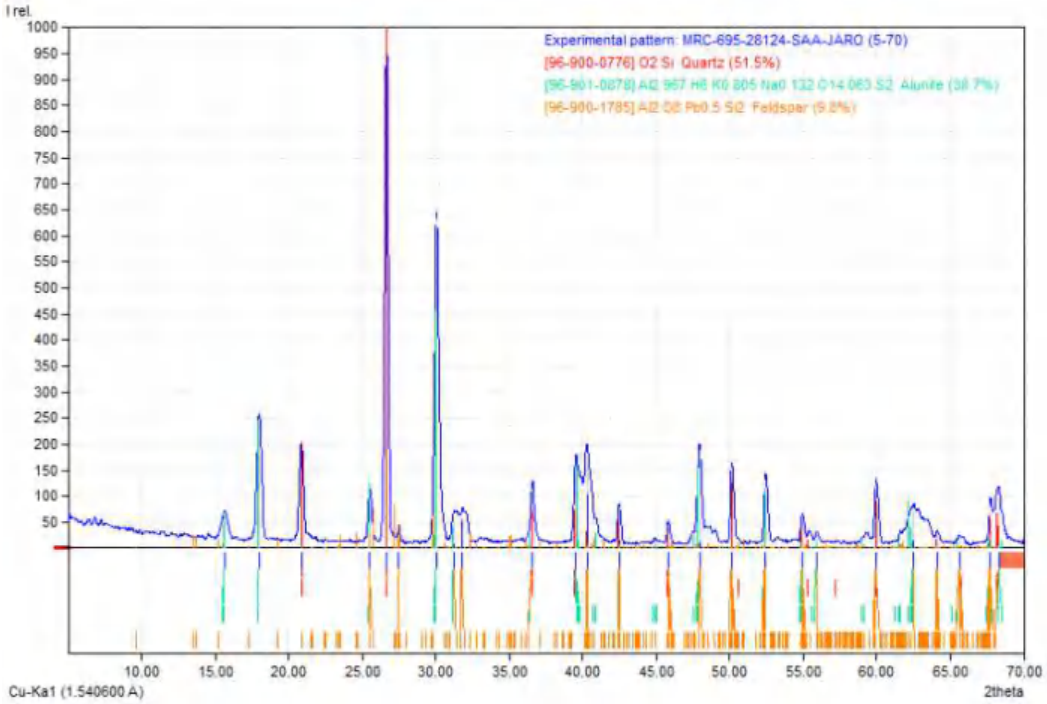
Formula sum	O2 Si
Entry number	96-900-0776
Figure-of-Merit (FoM)	0.935636
Total number of peaks	35
Peaks in range	18
Peaks matched	15
Intensity scale factor	1.00
Space group	P 32 2 1 S
Crystal system	trigonal (hexagonal axes)
Unit cell	a= 4.9160 Å c= 5.4054 Å
I/Ic	3.30
Calc. density	2.646 g/cm³
Reference	Levien L., Prewitt C. T., Weidner D. J., "Structure and elastic properties of quartz at pressureP = 1 atm", American Mineralogist **65**, 920-930 (1980)

B: Feldspar (9.8 %)

Formula sum	Al2 O8 Pb0.5 Si2
Entry number	96-900-1785
Figure-of-Merit (FoM)	0.390200
Total number of peaks	289
Peaks in range	289
Peaks matched	62
Intensity scale factor	0.08
Space group	I 1 2/c 1
Crystal system	monoclinic
Unit cell	a= 8.3880 Å b= 13.0670 Å c= 14.3270 Å β= 115.190 °
I/Ic	1.44
Calc. density	3.195 g/cm³
Reference	Benna P., Tribaudino M., Bruno E., "The structure of ordered and disordered lead feldspar (PbAl2Si2O8)Sample: ordered", American Mineralogist **81**, 1337-1343 (1996)

C: Alunite (38.7 %)

Formula sum	Al2.967 H6 K0.805 Na0.132 O14.063 S2
Entry number	96-901-0878
Figure-of-Merit (FoM)	0.843419
Total number of peaks	102
Peaks in range	49
Peaks matched	30
Intensity scale factor	0.45
Space group	R -3 m
Crystal system	trigonal (hexagonal axes)
Unit cell	a= 6.9741 Å c= 17.1900 Å
I/Ic	2.00
Calc. density	2.819 g/cm³



6	27.50	3.2408	38.35	7.16	0.1369	B
7	30.08	2.9685	631.30	263.07	0.3056	C
8	31.28	2.8573	53.50	45.91	0.6293	B,C
9	31.82	2.8100	58.26	81.39	1.0245	B
10	36.56	2.4558	112.41	41.56	0.2711	A,B,C
11	39.56	2.2762	156.99	99.87	0.4665	A,C
12	40.32	2.2351	154.48	242.17	1.1497	A,B
13	42.48	2.1263	77.02	23.01	0.2191	A,B
14	45.80	1.9796	42.36	12.25	0.2121	A,B
15	47.96	1.8953	187.35	82.29	0.3221	B,C
16	50.16	1.8172	154.21	51.90	0.2468	A,B
17	52.44	1.7435	131.91	44.94	0.2498	B,C
18	54.92	1.6705	53.07	16.66	0.2301	A,B,C
19	55.90	1.6435	17.02	5.36	0.2311	B,C
20	59.96	1.5415	119.96	44.77	0.2737	A,B

21	62.52	1.4844	69.14	113.14	1.2000	B,C
22	64.08	1.4520	20.84	21.14	0.7440	A,B
23	65.60	1.4220	13.65	7.87	0.4229	A,B,C
24	67.74	1.3822	82.05	32.22	0.2880	A,B,C
25	68.32	1.3718	95.76	93.72	0.7177	A,B,C

Integrated Profile Areas

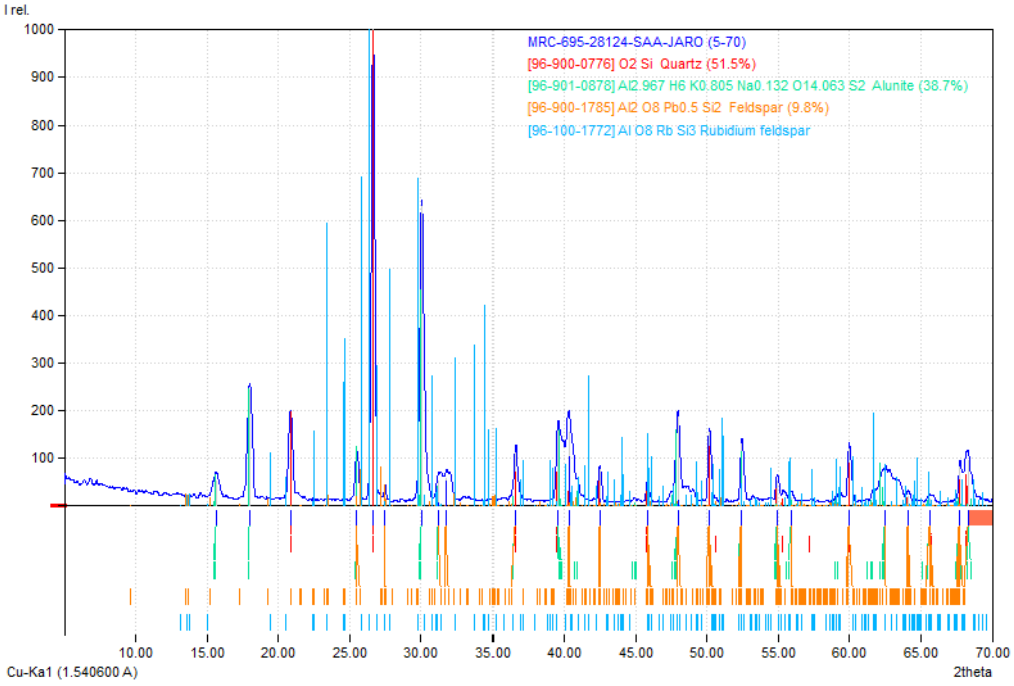
Based on calculated profile

Profile area	***Counts***	***Amount***
Overall diffraction profile	133736	100.00%
Background radiation	51042	38.17%
Diffraction peaks	82694	61.83%
Peak area belonging to selected phases	56727	42.42%
Peak area of phase A (Quartz)	*27155*	*20.30%*
Peak area of phase B (Alunite)	*24405*	*18.25%*
Peak area of phase C (Feldspar)	*5167*	*3.86%*
Unidentified peak area	25967	19.42%

Peak Residuals

Peak data	***Counts***	***Amount***
Overall peak intensity	1941	100.00%
Peak intensity belonging to selected phases	1815	93.53%
Unidentified peak intensity	126	6.47%

Diffraction Pattern Graphics



LP 57

Match! Phase Analysis Report

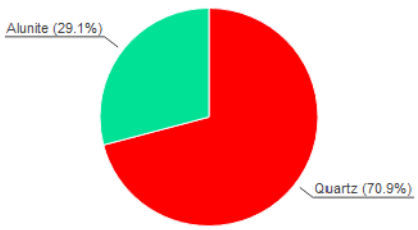
Sample: MRC-705-17-JAN-24-ASG (5-70)

Sample Data

File name	MRC-705-17-JAN-24-ASG.RAW
File path	D:/FRYAN/XRD AGE/MRC-705-17-JAN-24-ASG
Data collected	May 9, 2024 20:53:19
Data range	5.000° - 70.000°
Original data range	5.000° - 70.000°
Number of points	3251
Step size	0.020
Rietveld refinement converged	No
Alpha2 subtracted	No
Background subtr.	No
Data smoothed	Yes
Radiation	X-rays
Wavelength	1.540600 Å

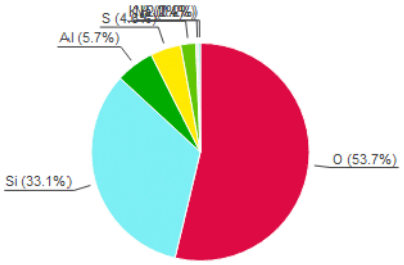
Analysis Results

Phase composition (Weight %) calc. by RIR method



Index	*Amount (%)*	*Name*	*Formula sum*
A	70.9	Quartz	O2 Si
B	29.1	Alunite	Al2.967 H6 K0.805 Na0.132 O14.063 S2
	14.2	*Unidentified peak area*	

Elemental composition (Weight %) calc. by RIR method



Element	*Amount (weight %)*
O	*53.7%(*)*
Si	33.1%
Al	5.7%
S	4.6%
K	2.2%
H	*0.4%(*)*
Na	0.2%
**LE (sum)*	*54.2%*

Details of identified phases

A: Quartz (70.9 %)

Formula sum	O2 Si
Entry number	96-900-0776
Figure-of-Merit (FoM)	0.956196
Total number of peaks	35
Peaks in range	18
Peaks matched	15
Intensity scale factor	0.99
Space group	P 32 2 1 S
Crystal system	trigonal (hexagonal axes)
Unit cell	a= 4.9160 Å c= 5.4054 Å
I/Ic	3.30
Calc. density	2.646 g/cm³
Reference	Levien L., Prewitt C. T., Weidner D. J., "Structure and elastic properties of quartz at pressureP = 1 atm", American Mineralogist **65**, 920-930 (1980)

B: Alunite (29.1 %)

Formula sum	Al2.967 H6 K0.805 Na0.132 O14.063 S2

Entry number	96-901-0878
Figure-of-Merit (FoM)	0.839646
Total number of peaks	102
Peaks in range	49
Peaks matched	29
Intensity scale factor	0.25
Space group	R -3 m
Crystal system	trigonal (hexagonal axes)
Unit cell	a= 6.9741 Å c= 17.1900 Å
I/Ic	2.00
Calc. density	2.819 g/cm³
Reference	Majzlan J., Speziale S., Duffy T. S., Burns P. C., "Single-crystal elastic properties of alunite, KAl3(SO4)2(OH)6", Physics and Chemistry of Minerals **33**, 567-573 (2006)

Search-Match

Settings

Reference database used	COD-Inorg 2024.06.03
Method	Peak-based search-match
Automatic zeropoint adaptation	Yes
Downgrade entries with low scaling factors	Yes
Minimum figure-of-merit (FoM)	0.50
2theta window for peak corr.	0.30 deg.
Minimum rel. int. for peak corr.	1
Parameter/influence 2theta	0.50
Parameter/influence intensities	0.50
Parameter multiple/single phase(s)	0.50

Peak List

No.	*2theta [°]*	*d [Å]*	*I/I0 (peak height)*	*Counts (peak area)*	*FWHM*	*Matched*
1	15.56	5.6903	25.05	24.90	0.4022	B
2	17.96	4.9350	95.78	79.68	0.3367	B
3	20.86	4.2550	155.44	114.63	0.2984	A
4	25.52	3.4876	49.42	30.16	0.2470	B
5	26.66	3.3410	1000.00	585.93	0.2371	A
6	30.04	2.9723	252.85	188.47	0.3017	B
7	31.18	2.8662	33.74	38.34	0.4599	B
8	36.58	2.4545	85.56	48.63	0.2300	A,B
9	39.54	2.2773	147.29	124.85	0.3430	A,B
10	40.26	2.2383	65.67	116.12	0.7156	A
11	42.50	2.1253	60.74	34.38	0.2291	A
12	45.80	1.9796	42.44	22.92	0.2186	A
13	47.88	1.8983	86.37	65.94	0.3090	B
14	50.16	1.8172	139.64	84.22	0.2441	A
15	52.40	1.7447	56.30	32.96	0.2370	B
16	54.88	1.6716	39.75	26.44	0.2692	A,B
17	55.36	1.6582	16.59	19.25	0.4695	A,B
18	59.96	1.5415	93.54	62.97	0.2724	A
19	62.36	1.4878	38.59	101.77	1.0673	B
20	64.06	1.4524	15.32	13.47	0.3560	A
21	67.74	1.3822	64.49	48.34	0.3034	A,B
22	68.32	1.3718	83.54	107.14	0.5191	A,B

Integrated Profile Areas

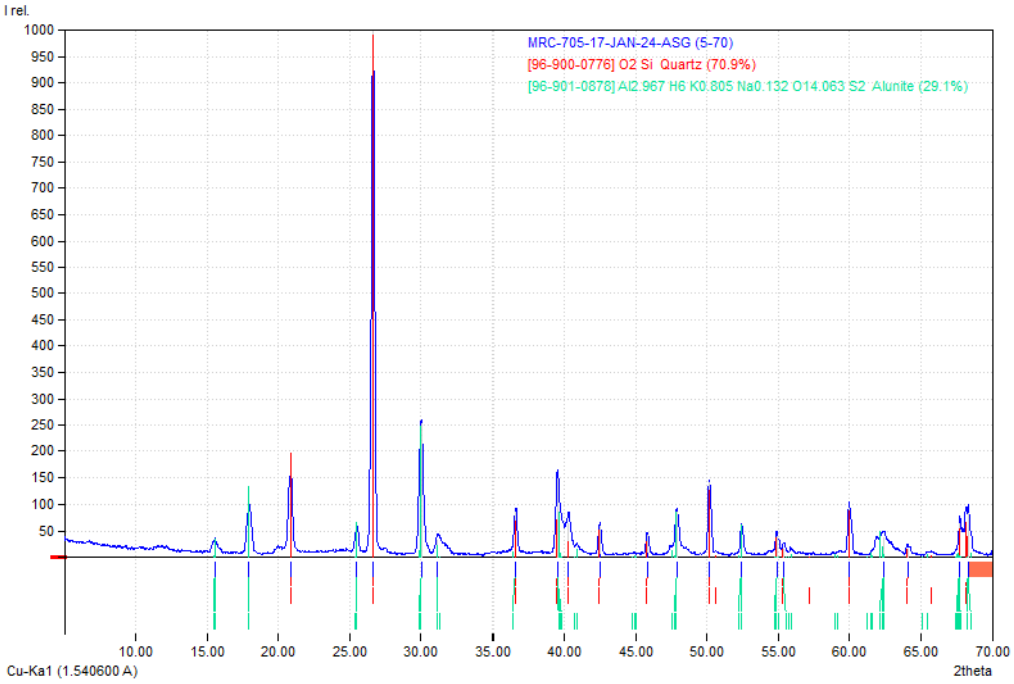
Based on calculated profile

Profile area	***Counts***	***Amount***
Overall diffraction profile	150992	100.00%
Background radiation	59356	39.31%
Diffraction peaks	91636	60.69%
Peak area belonging to selected phases	70152	46.46%
Peak area of phase A (Quartz)	*46006*	*30.47%*
Peak area of phase B (Alunite)	*24146*	*15.99%*
Unidentified peak area	21484	14.23%

Peak Residuals

Peak data	***Counts***	***Amount***
Overall peak intensity	1971	100.00%
Peak intensity belonging to selected phases	1943	98.58%
Unidentified peak intensity	28	1.42%

Diffraction Pattern Graphics



LP 66

Match! Phase Analysis Report

Sample: MRC-715-4-JAN-24-02 (5-70)

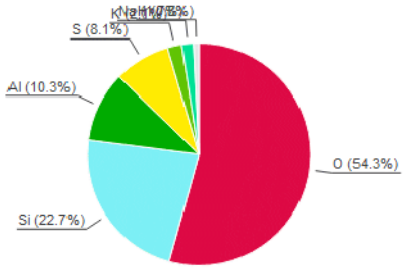
Sample Data

File name	MRC-715-4-JAN-24-02.RAW
File path	D:/FRYAN/XRD AGE/MRC-715-4-JAN-24-02
Data collected	May 9, 2024 20:53:19
Data range	5.000° - 70.000°
Original data range	5.000° - 70.000°
Number of points	3251
Step size	0.020
Rietveld refinement converged	No
Alpha2 subtracted	No
Background subtr.	No
Data smoothed	Yes
Radiation	X-rays
Wavelength	1.540600 Å

Analysis Results

Phase composition (Weight %) calc. by RIR method

Elemental composition (Weight %) calc. by RIR method



Index	*Amount (%)*	*Name*	*Formula sum*
A	48.6	Quartz	O2 Si
B	51.4	Natroalunite	Al3 H6 K0.42 Na0.58 O14 S2
	18.7	*Unidentified peak area*	

Element	*Amount (weight %)*
O	*54.3%(*)*
Si	22.7%
Al	10.3%
S	8.1%
K	2.1%
Na	1.7%
H	*0.8%(*)*
**LE (sum)*	*55.1%*

Details of identified phases

A: Quartz (48.6 %)

Formula sum	O2 Si
Entry number	96-900-5018
Figure-of-Merit (FoM)	0.933567
Total number of peaks	35
Peaks in range	18
Peaks matched	15
Intensity scale factor	1.19
Space group	P 32 2 1 S
Crystal system	trigonal (hexagonal axes)
Unit cell	a= 4.9137 Å c= 5.4047 Å
I/Ic	3.31
Calc. density	2.649 g/cm³
Reference	Kihara K., "An X-ray study of the temperature dependence of the quartz structureSample: at T = 298 K", European Journal of Mineralogy **2**, 63-77 (1990)

B: Natroalunite (51.4 %)

Formula sum	Al3 H6 K0.42 Na0.58 O14 S2
Entry number	96-900-9298
Figure-of-Merit (FoM)	0.877556
Total number of peaks	100
Peaks in range	48
Peaks matched	31
Intensity scale factor	0.69
Space group	R -3 m
Crystal system	trigonal (hexagonal axes)
Unit cell	a= 6.9900 Å c= 16.9050 Å
I/Ic	1.82
Calc. density	2.820 g/cm³
Reference	Okada K., Hirabayashi J., Ossaka J., "Crystal structure of natroalunite and crystal chemistry of the alunite group", Neues Jahrbuch fur Mineralogie, Monatshefte **1982**, 534-540 (1982)

Search-Match

Settings

Reference database used	COD-Inorg 2024.06.03
Method	Peak-based search-match
Automatic zeropoint adaptation	Yes
Downgrade entries with low scaling factors	Yes
Minimum figure-of-merit (FoM)	0.50
2theta window for peak corr.	0.30 deg.
Minimum rel. int. for peak corr.	1
Parameter/influence 2theta	0.50
Parameter/influence intensities	0.50
Parameter multiple/single phase(s)	0.50

Criteria for entries added by user

Reference:

Entry number: 96-900-0014;96-900-0035;96-900-9285;96-900-9298;96-901-0878;96-901-2351;96-901-4709;96-901-5097;96-901-5625;96-901-6103;96-901-6393;96-901-6446;96-901-6498;96-900-1665;96-900-3815;96-900-4787;96-900-4919;96-900-7429;96-900-7612;96-900-9523;96-900-9666;96-901-0118;96-901-0494;96-901-0549;96-901-1123;96-901-1745;96-901-1746;96-901-2893;96-901-3719;96-901-3720;96-901-3721;96-901-3722;96-901-3723;96-901-3724;96-901-3733;96-901-3985;96-901-4065;96-901-6664;96-101-1046;96-154-4873;96-155-0599;96-900-9231;96-900-9235;96-901-5000;96-101-0914;96-101-0930;96-101-0941;96-154-4892;96-154-4893;96-154-4894;96-210-4742;96-210-4743;96-210-4753;96-210-4754;96-500-0116;96-900-0110;96-900-0595;96-900-0596;96-900-6171;96-900-6172;96-900-7573;96-901-0012;96-901-3070;96-901-3071;96-901-3072;96-901-3409;96-901-3698;96-901-5006;96-901-5235;96-901-5637;96-901-5843;96-901-6640;96-900-0123;96-900-3082;96-900-3083;96-901-3920;96-901-3940

Peak List

No.	*2theta [°]*	*d [Å]*	*I/I0 (peak height)*	*Counts (peak area)*	*FWHM*	*Matched*
1	12.26	7.2136	11.79	6.22	0.4647	
2	15.72	5.6328	56.39	26.25	0.4102	B
3	18.10	4.8971	257.20	101.56	0.3479	B
4	20.82	4.2631	146.80	67.50	0.4052	A
5	25.56	3.4822	109.57	31.31	0.2518	B
6	26.68	3.3385	1000.00	273.59	0.2411	A
7	30.12	2.9646	770.53	229.71	0.2627	B
8	31.80	2.8117	138.49	55.57	0.3536	B
9	36.60	2.4532	120.94	38.92	0.2836	A,B
10	39.52	2.2784	71.56	23.72	0.2921	A
11	40.30	2.2361	364.10	157.47	0.3811	A,B
12	40.94	2.2026	51.98	16.68	0.2828	B
13	42.50	2.1253	66.23	16.02	0.2132	A
14	45.80	1.9796	42.88	12.51	0.2571	A
15	47.98	1.8946	226.19	66.09	0.2574	B
16	48.56	1.8733	62.09	39.44	0.5597	B
17	50.18	1.8166	150.28	40.06	0.2349	A
18	52.44	1.7435	144.01	40.39	0.2471	B
19	54.90	1.6710	55.59	11.92	0.1889	A,B
20	55.92	1.6429	25.63	4.91	0.1689	B
21	59.98	1.5411	105.85	34.71	0.2889	A
22	61.76	1.5009	24.55	20.74	0.7443	B
23	62.66	1.4814	81.05	110.35	1.1997	B
24	63.08	1.4726	104.58	92.92	0.7829	B
25	64.04	1.4528	16.09	9.93	0.5435	A
26	65.78	1.4185	17.91	5.76	0.2836	A
27	67.76	1.3818	76.45	21.83	0.2517	A,B
28	68.32	1.3718	105.76	76.90	0.6407	A,B

Integrated Profile Areas

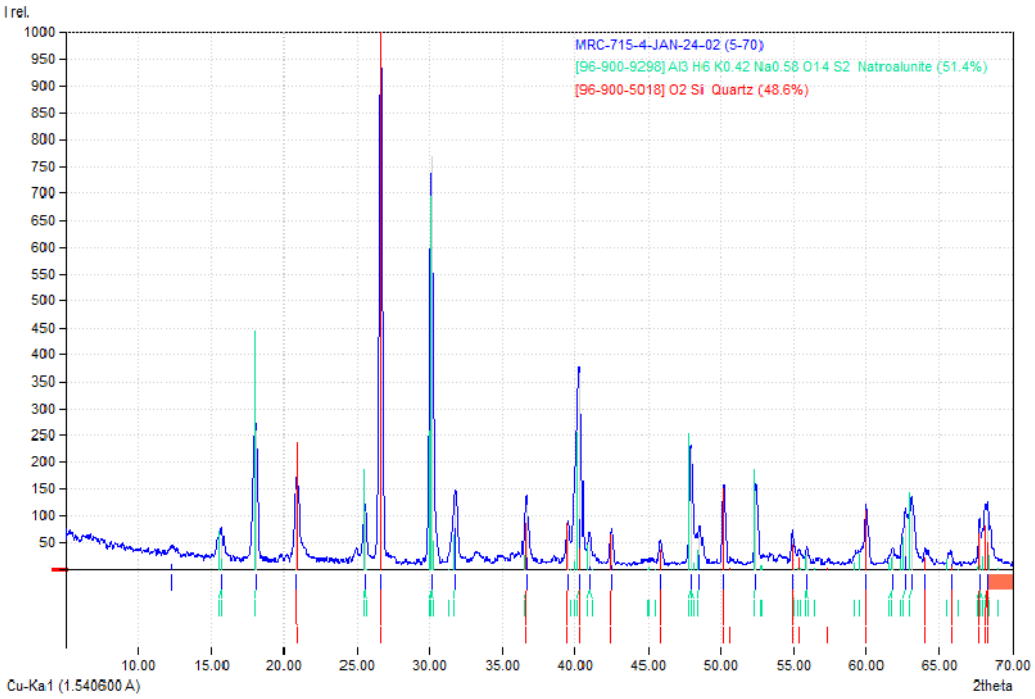
Based on calculated profile

Profile area	*Counts*	*Amount*
Overall diffraction profile	124488	100.00%
Background radiation	52954	42.54%
Diffraction peaks	71534	57.46%
Peak area belonging to selected phases	48227	38.74%
Peak area of phase A (Natroalunite)	*26289*	*21.12%*
Peak area of phase B (Quartz)	*21939*	*17.62%*
Unidentified peak area	23307	18.72%

Peak Residuals

Peak data	*Counts*	*Amount*
Overall peak intensity	1633	100.00%
Peak intensity belonging to selected phases	1590	97.35%
Unidentified peak intensity	43	2.65%

Diffraction Pattern Graphics



LP 67

Match! Phase Analysis Report

Sample: MRC-715-4-JAN-24-03 (5-70)

Sample Data

File name	MRC-715-4-JAN-24-03.RAW
File path	D:/FRYAN/XRD AGE/MRC-715-4-JAN-24-03
Data collected	May 9, 2024 20:53:19
Data range	5.000° - 70.000°
Original data range	5.000° - 70.000°
Number of points	3251
Step size	0.020
Rietveld refinement converged	No
Alpha2 subtracted	No
Background subtr.	No
Data smoothed	Yes
Radiation	X-rays
Wavelength	1.540600 Å

Analysis Results

Phase composition (Weight %) calc. by RIR method

Elemental composition (Weight %) calc. by RIR method

Index	*Amount (%)*	*Name*	*Formula sum*
A	100.0	Quartz	O2 Si
	13.2	*Unidentified peak area*	

Element	*Amount (weight %)*
O	*53.3%(*)*
Si	46.7%
**LE (sum)*	*53.3%*

Details of identified phases

A: Quartz (100.0 %)

Formula sum	O2 Si
Entry number	96-900-5018
Figure-of-Merit (FoM)	0.984101
Total number of peaks	35
Peaks in range	18
Peaks matched	15
Intensity scale factor	1.01
Space group	P 32 2 1 S
Crystal system	trigonal (hexagonal axes)
Unit cell	a= 4.9137 Å c= 5.4047 Å
I/Ic	3.31
Calc. density	2.649 g/cm³
Reference	Kihara K., "An X-ray study of the temperature dependence of the quartz structureSample: at T = 298 K", European Journal of Mineralogy **2**, 63-77 (1990)

Search-Match

Settings

Reference database used	COD-Inorg 2024.06.03
Method	Peak-based search-match
Automatic zeropoint adaptation	Yes
Downgrade entries with low scaling factors	Yes
Minimum figure-of-merit (FoM)	0.50
2theta window for peak corr.	0.30 deg.
. for peak corr.	1
ance 2theta	0.50
ance intensities	0.50
iple/single phase(s)	0.50

Criteria for entries added by user

Reference:

Entry number: 96-900-0014;96-900-0035;96-900-9285;96-900-9298;96-901-0878;96-901-2351;96-901-4709;96-901-5097;96-901-5625;96-901-6103;96-901-6393;96-901-6446;96-901-6498

Peak List

No.	*2theta [°]*	*d [Å]*	*I/I0 (peak height)*	*Counts (peak area)*	*FWHM*	*Matched*
1	20.88	4.2510	159.41	171.69	0.3045	A
2	26.68	3.3385	1000.00	868.45	0.2455	A
3	36.60	2.4532	85.67	74.26	0.2450	A
4	39.52	2.2784	78.57	60.55	0.2179	A
5	40.32	2.2351	41.81	33.86	0.2290	A
6	42.52	2.1244	60.57	50.53	0.2359	A
7	45.84	1.9779	41.68	32.96	0.2236	A
8	50.18	1.8166	153.51	125.77	0.2316	A
9	54.90	1.6710	46.07	41.24	0.2531	A
10	55.36	1.6582	20.93	16.78	0.2267	A
11	59.98	1.5411	96.94	95.76	0.2793	A
12	64.08	1.4520	22.56	21.58	0.2705	A
13	67.76	1.3818	59.41	54.64	0.2600	A
14	68.34	1.3715	85.15	137.79	0.4575	A

Integrated Profile Areas

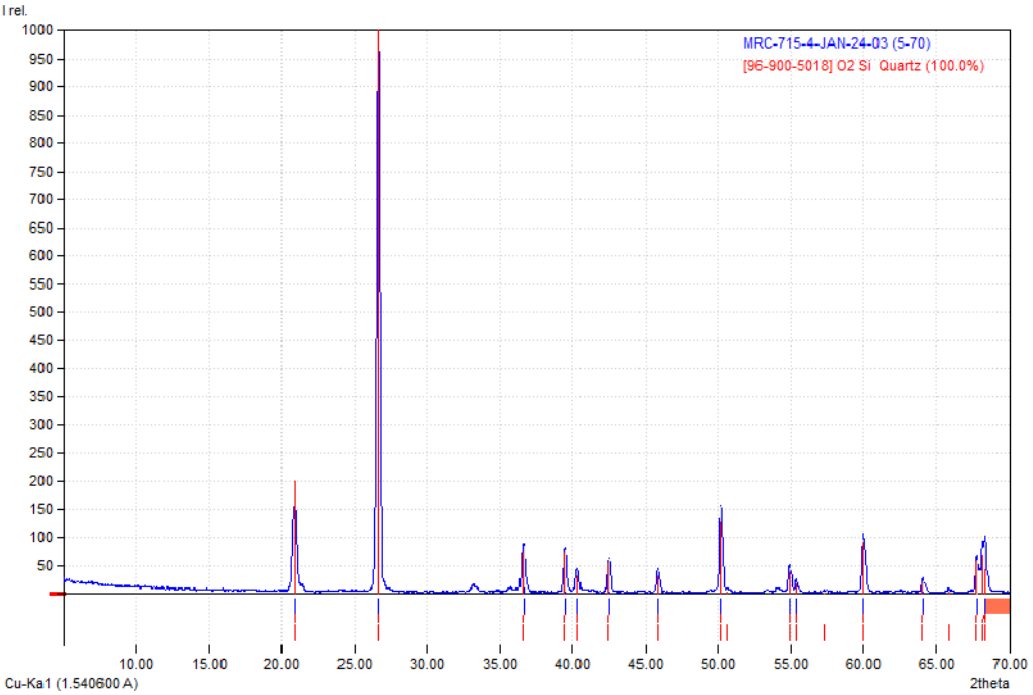
Based on calculated profile

Profile area	***Counts***	***Amount***
Overall diffraction profile	134920	100.00%
Background radiation	50235	37.23%
Diffraction peaks	84686	62.77%
Peak area belonging to selected phases	66930	49.61%
Peak area of phase A (Quartz)	*66930*	*49.61%*
Unidentified peak area	17755	13.16%

Peak Residuals

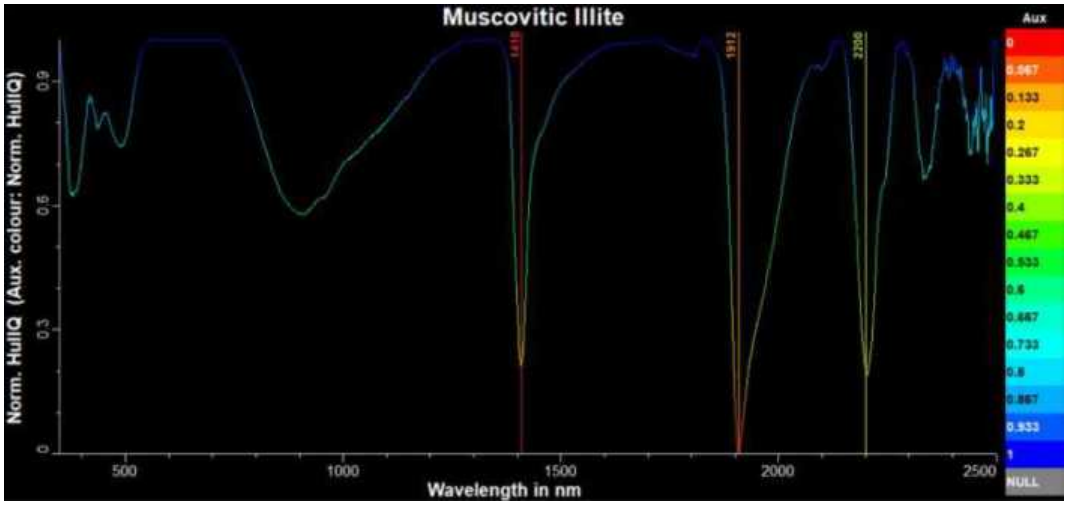
Peak data	***Counts***	***Amount***
Overall peak intensity	1786	100.00%
Peak intensity belonging to selected phases	1761	98.63%
Unidentified peak intensity	24	1.37%

Diffraction Pattern Graphics

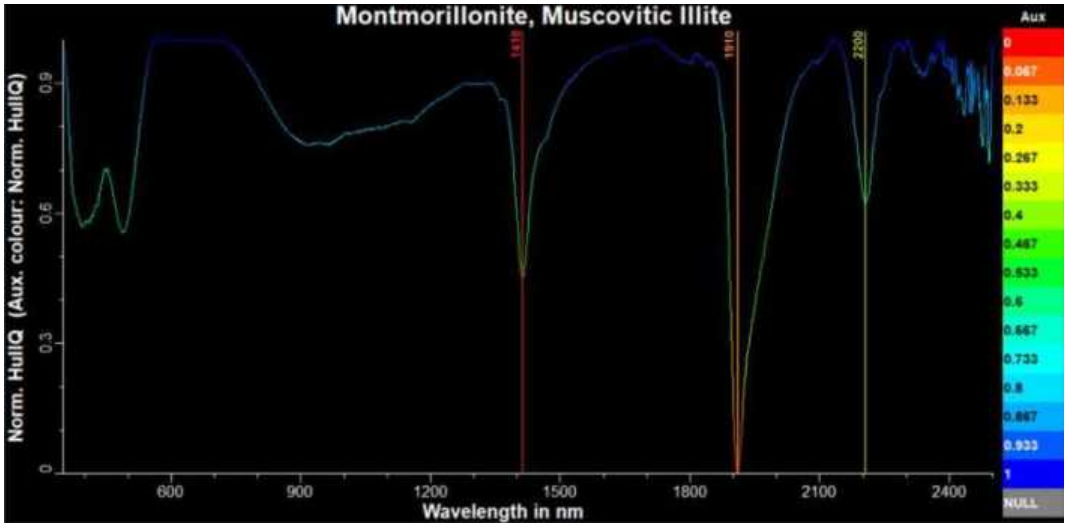


Lampiran 4 Analisis ASD

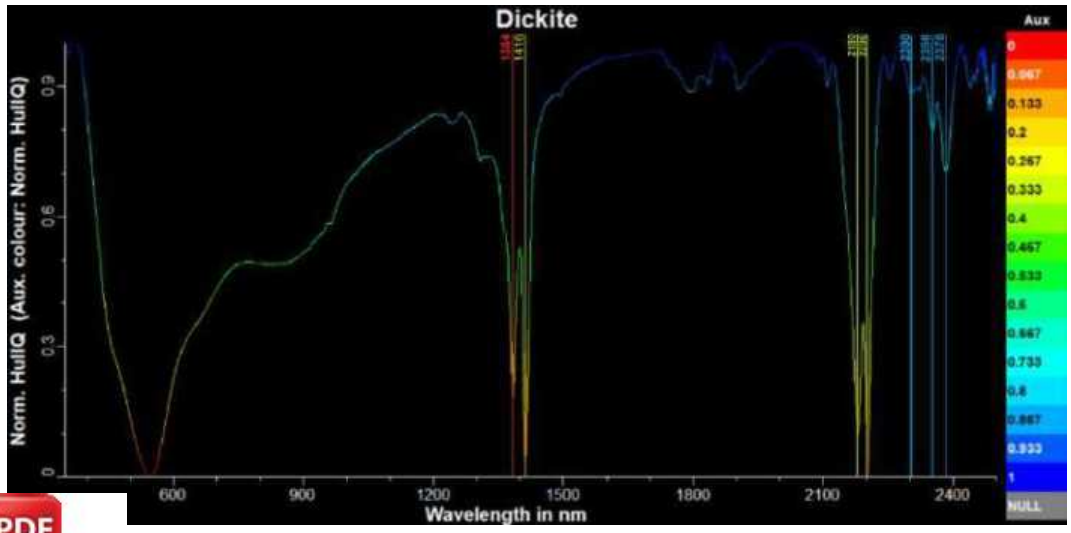
LP 1



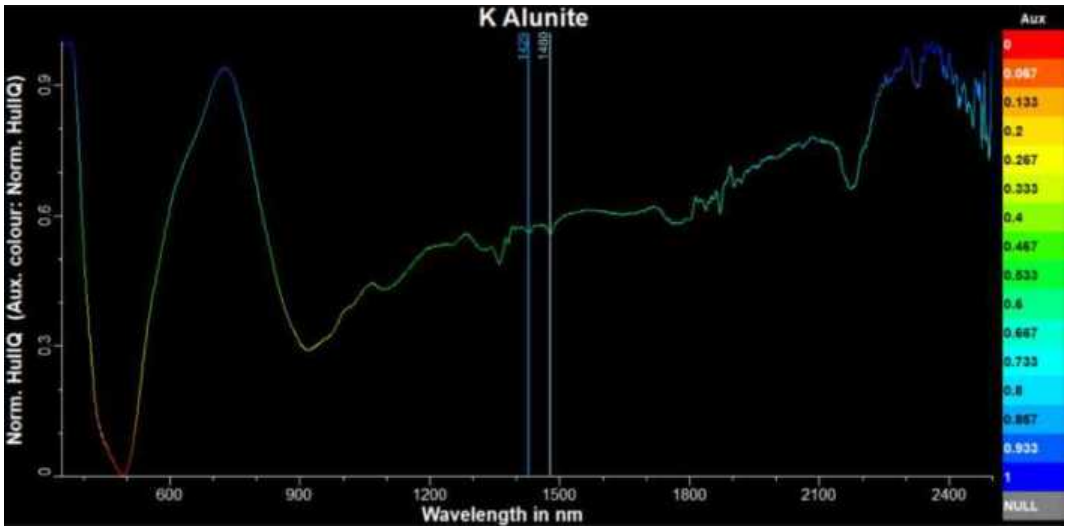
LP 5



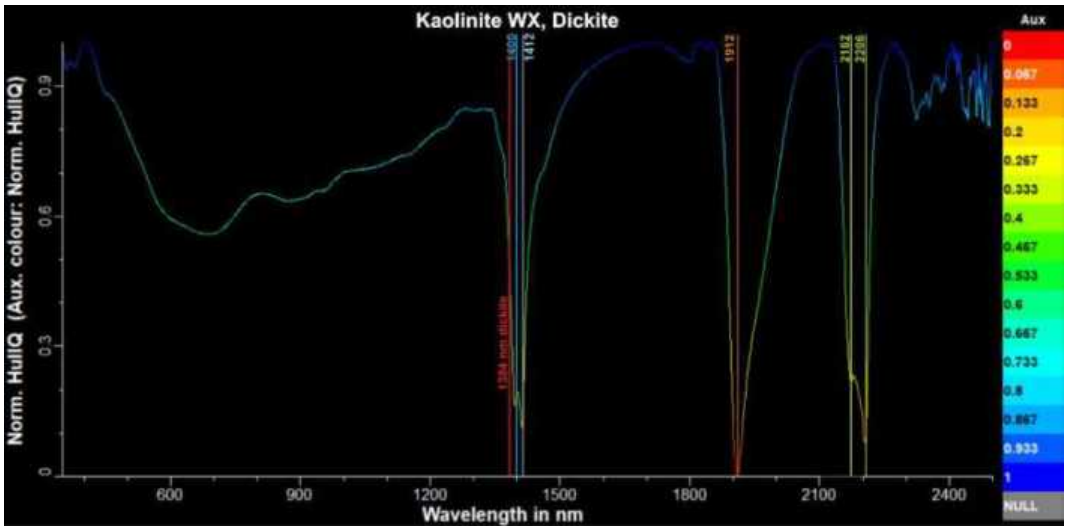
LP 8



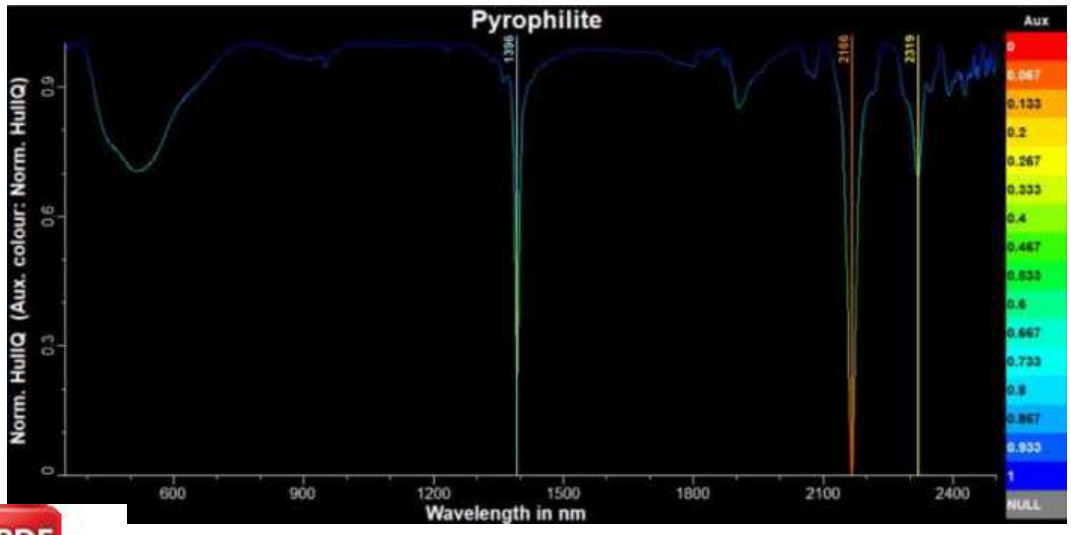
LP 14



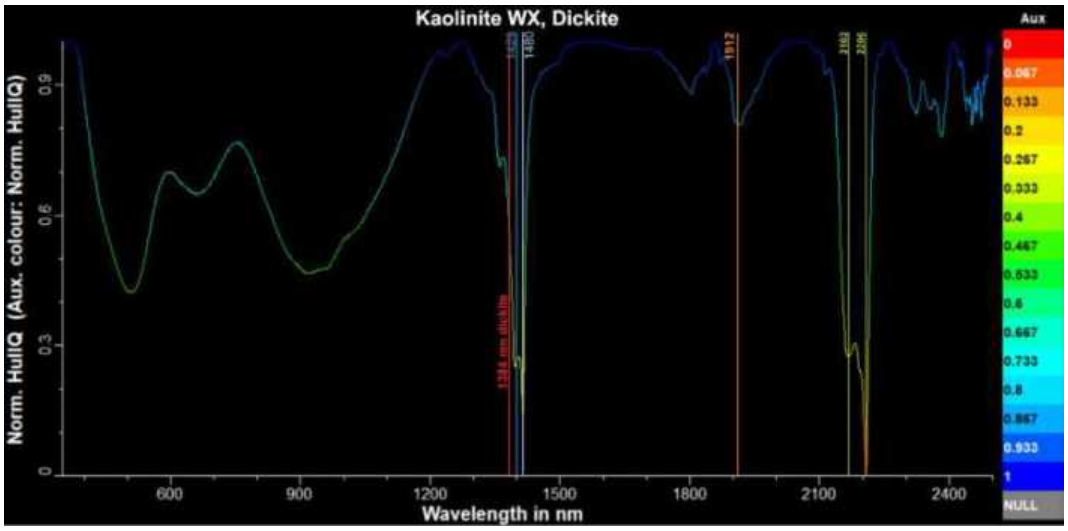
LP 16



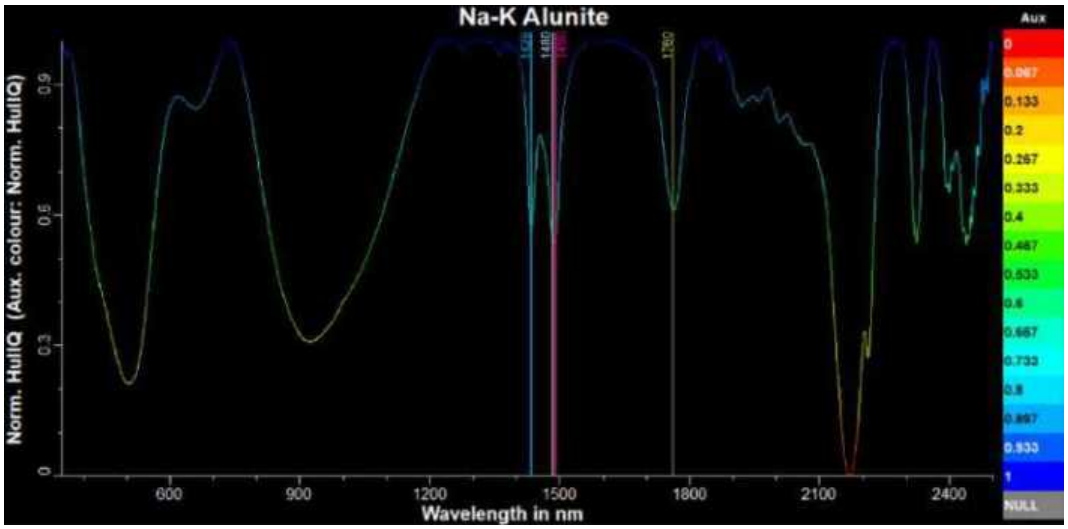
LP 23



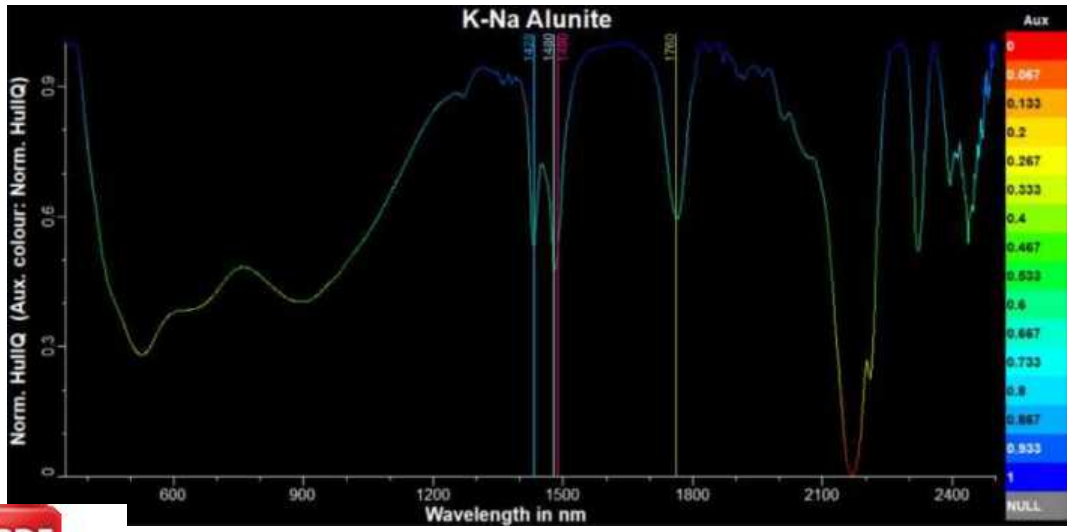
LP 34



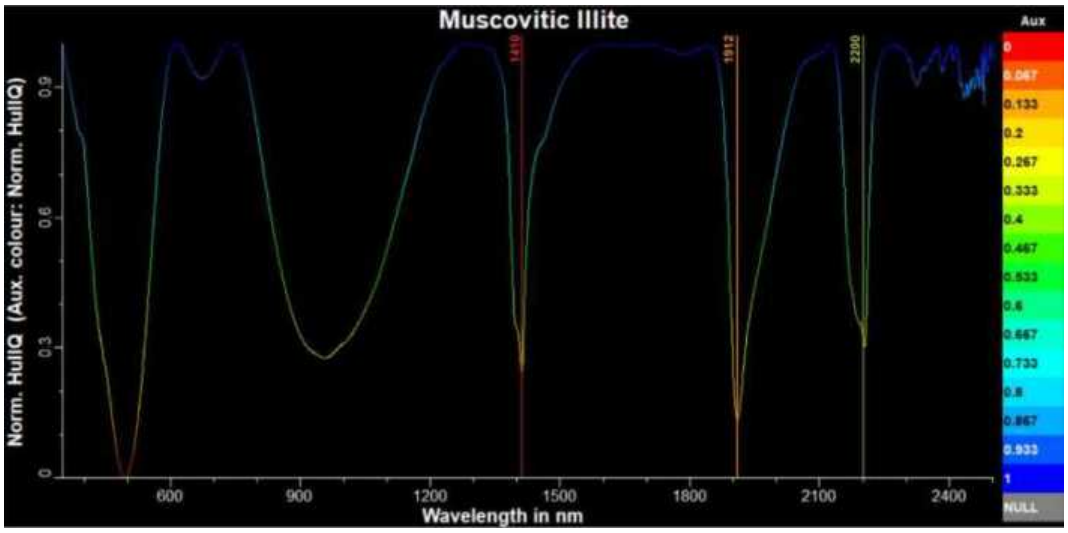
LP 42



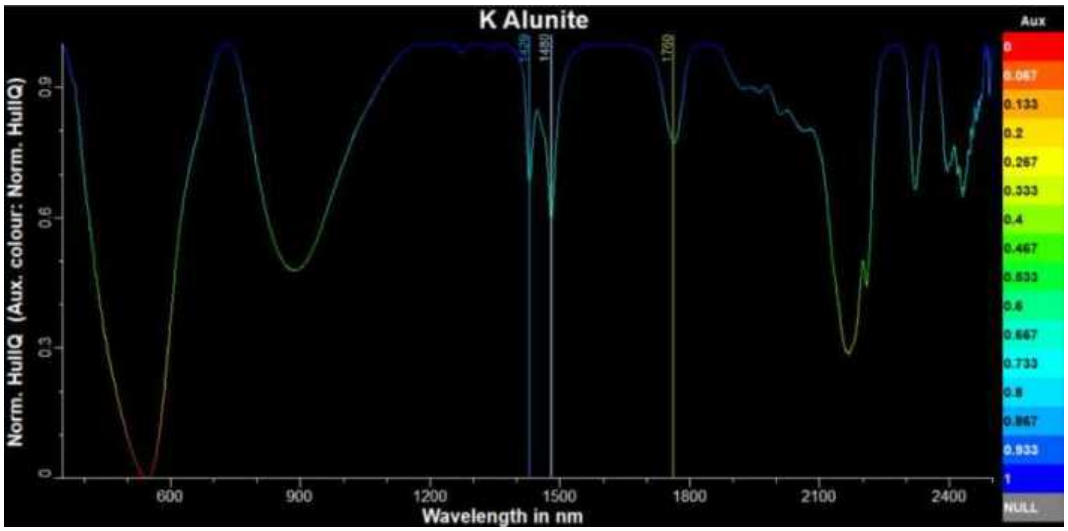
LP 43



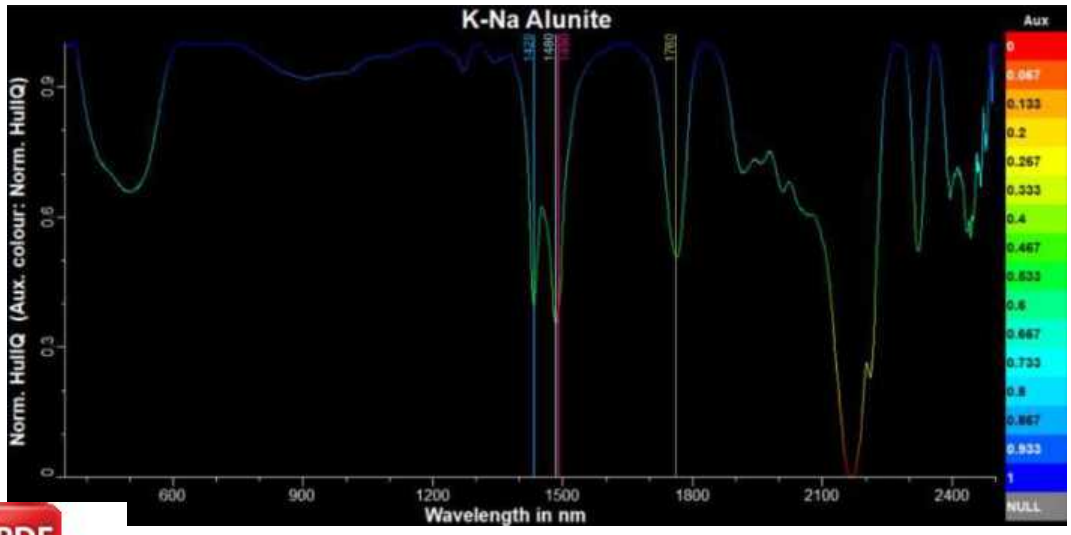
LP 38



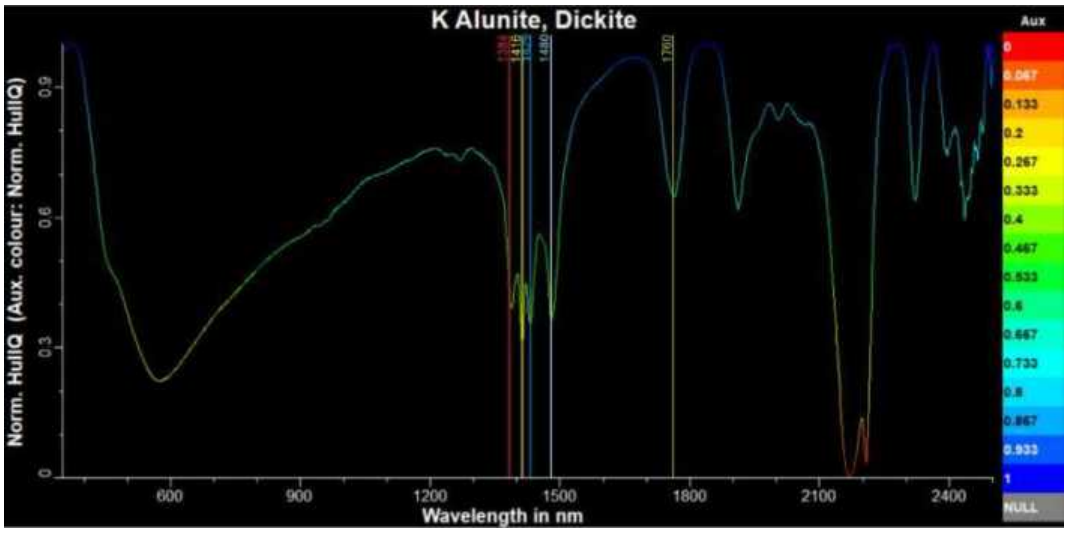
LP 47



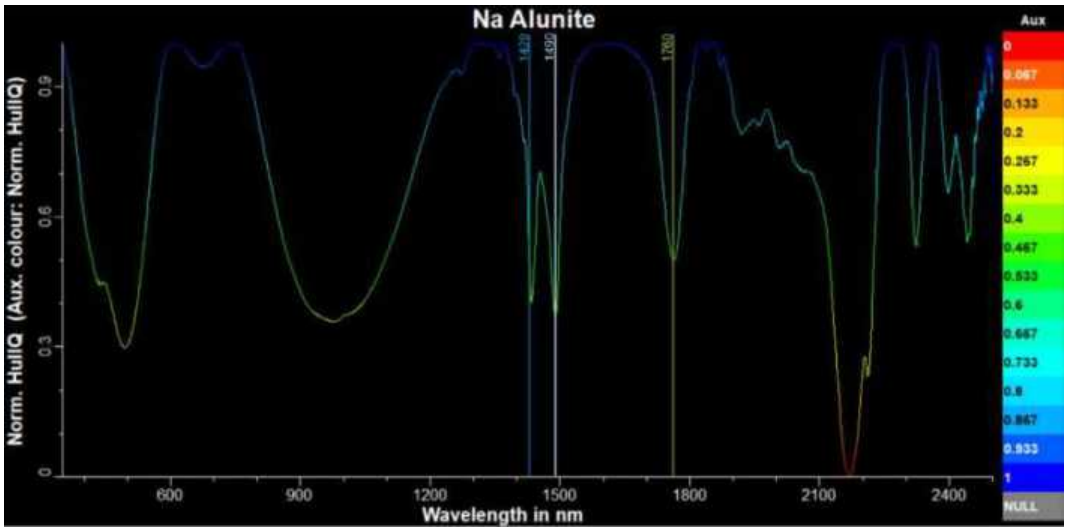
LP 52



LP 57



LP 66



Lampiran 5 Deskripsi lapangan dan analisis ASD

LP	LITOLOGI	ALTERASI	MINERAL OKSIDA (ASD)	ASD
LP 1	BF	AR	Goe-Jaro	*Muscovitic Illite*
LP 2	BF	AA	Hem	*K-Na Alunite*
LP 3	BF	AA	Hem	*Na-Alunite*
LP 4	BF	AA	Hem	*Na-Alunite*
LP 5	TFDA	AR	-	*Monmorillonite ± Muscovitic Illite*
LP 6	TFDA	AR	-	-
LP 7	BF	AA	Hem	-
LP 8	BF	AA	Hem	*Dickite*
LP 9	BF	AA	Hem	-
LP 10	BF	AA	Goe	-
LP 11	BHX	S	Goe-Hem	-
LP 13	BF	S	Hem	*K-Alunite*
LP 14	BF	VQ	Hem	*K-Alunite*
LP 15	BF	S	-	-
LP 16	BF	AR	Weak Goe	*Kaolinite PX ± Dickite*
LP 17	BF	AA	-	-
LP 18	BF	AR	-	-
LP 19	BF	AR	-	-
LP 20	TFDA	AA	Hem	*K-Alunite, K-Na Alunite*
LP 21	TFDA	AA	Hem	*K-Na Alunite, Na-Alunite ± Kaolinite WX*
LP 22	TFDA	AA	Goe-Hem	*K-Alunite*
LP 23	TFDA	AA	Hem	*Pyrophyllite*
LP 24	TFDA	AA	-	-
LP 25	TFDA	AR	-	*Kaolinite PX*
LP 26	TFDA	AA	Goe	*Kaolinite WX*
LP 27	TFDA	AR	Jar	*Kaolinite PX*
LP 29	TFDA	AR	Jar	*Pyrophyllite*
LP 30	TFDA	AA	Goe-Hem	*K-Alunite*
LP 31	TFDA	VQ	Hem	*Monmorillonite*
LP 33	TFDA	AA	Hem	*K-Alunite ± Kaolinite WX*
LP 34	TFDA	AA	Hem	*Kaolinite WX ± Dickite*
LP 35	TFDA	AA	-	*Na-Alunite ± Kaolinite WX*
LP 36	TFDA	AR	-	*Kaolinite WX*
LP 37	TFDA	AR	Jar-Weak Goe	*Kaolinite WX*
LP 38	TFDA	AR	Goe	*Muscovitic Illite*
LP 39	TFDA	AR	-	*Kaolinite PX*
LP 40	TFDA	AA	Hem	*Kaolinite WX*
	TFDA	AA	Hem	*Na-K Alunite*
	TFDA	AA	Hem	*Na Alunite*
	BF	AA	Goe-Hem	*K-Na Alunite*
	BF	AA	-	-
	BHX	S	-	-
	BHX	S	-	-

LP	LITOLOGI	ALTERASI	MINERAL OKSIDA (ASD)	ASD
LP 47	BHX	S	Hem	*K-Alunite*
LP 48	BF	AA	-	-
LP 49	BF	AA	-	-
LP 50	BF	AA	Weak Hem	*K-Alunite*
LP 51	TFDA	AA	-	-
LP 52	BF	AA	Hem, Weak Jar	*K-Na Alunite*
LP 53	BF	AA	Goe-Hem	*Kaolinite WX*
LP 54	TFDA	AR	Jar	*Paragonitic Illite*
LP 55	TFDA	AR	Jar-Goe	*Kaolinite WX ± Pyrophillite*
LP 56	BF	AA	Hem	*Pyrophyllite*
LP 57	BF	AA	Weak Hem-Goe	*K-Alunite*
LP 58	BF	AA	-	*K Alunite ± Dickite*
LP 59	BF	AA	Weak Goe	*Kaolinite WX*
LP 60	BF	S	Hem	*K Alunite*
LP 61	BF	AA	-	*Kaolinite WX*
LP 62	BF	AA	Hem-Jar	*K-Na Alunite*
LP 63	BF	S	Hem	*K-Alunite*
LP 64	BF	AA	Hem	*K-Na Alunite*
LP 65	BF	AA	Hem	*K-Alunite*
LP 66	BF	AA	-	*Kaolinite WX*
LP 67	TFDA	S	Hem	*Alunite*
LP 68	TFDA	S	-	-
LP 69	BF	AA	Goe	*Na-Alunite*
LP 70	BF	AR	-	*Pyrophyllite*
LP 71	BF	AR	-	-
LP 72	BF	AR	-	-
LP 73	BF	AR	-	-
LP 74	BF	AR	-	-
LP 75	BF	AR	-	-

Lampiran 6 *Logging* data bor

MRD-1297				
From	**To**	**M**	**Litologi**	**Alterasi**
129.9	185.9	56	BF	AA
185.9	187.9	2	BF	AA
187.9	188.9	1	BF	AR
188.9	189.1	0.2	BF	AA
189.1	201.45	12.35	BF	AR
200.45	200.7	0.25	BF	AA
200.7	215.4	14.7	BF	AA
215.4	215.5	0.1	BF	AR
215.5	218.5	3	BF	AA
217.25		217.25	*Vein*	
218.5	218.6	0.1	BF	AR
218.6	218.7	0.1	BF	AA
218.7	218.8	0.1	BF	AR
218.8	219.45	0.65	BF	AA
219.45	219.5	0.05	BF	AR
219.5	221.5	2	BF	AA
221.5	221.7	0.2	BF	AR
221.7	228.35	6.65	BF	AA
227.4		227.4	*Oxide Vein*	
227.5		227.5	*Oxide Vein*	
228.35	229	0.65	BF	AR
229	231.75	2.75	BF	AA
231.75	236.9	5.15	BF	AR
236.9	249	12.1	BF	AA
249	249.4	0.4	BF	AR
243.4	250	6.6	BF	AA
248.6	249.6	1	BF	AA

MRD-1347				
From	**To**	**M**	**Litologi**	**Alterasi**
148.4	149.5	1.1	BF	AA
149.5	150.05	0.55	BF	S
150.05	150.4	0.35	BF	AA
150.4	153.6	3.2	BF	AA
153.6	155	1.4	BF	AA
155	158.6	3.6	BF	AA
158.6	159.6	1	BF	AA
159.6	160.25	0.65	BF	AA
159.9		159.9	*Clay Gouge*	
160.25	161.45	1.2	BF	AA
161.45	161.6	0.15	*Clay Gouge*	
161.6	163.95	2.35	BF	AA
163.95	165.6	1.65	BF	AA
164.8		164.8	*Clay Gouge*	
165.6	167	1.4	BF	AA
167	168.6	1.6	BF	AA
168.6	185.2	16.6	BF	AA
185.2	186	0.8	BF	AA
186	190	4	BF	AA
189.6		189.6	*Clay Gouge*	
190	191	1	BF	AA
191	191.5	0.5	BF	AR
191.5	192.9	1.4	BF	AA
192.9	193.4	0.5	BF	AA
193.4	195.6	2.2	BF	AA
195.6	196.7	1.1	BF	AR
196.7	207.7	11	BF	AA
207.7	209.15	1.45	BF	AR
209.15	214.7	5.55	BF	AA
214.7	215.4	0.7	BF	AR
215.4	215.5	0.1	BF	AA
215.5	217	1.5	BF	AA
216		216	*Clay Gouge*	
217	217.8	0.8	BF	AR
217.8	254.7	36.9	BF	AA
254.7	255.8	1.1	BF	AR
255.8	270	14.2	ID	P

MRD-1320				
From	**To**	**M**	**Litologi**	**Alterasi**
90.7	111.6	20.9	BF	AR
111.6	113.5	1.9	BF	AA
113.5	113.7	0.2	BF	AR
113.7	114.6	0.9	BF	AA
114.6	116.1	1.5	BF	AA
116.1	117.2	1.1	BF	AA
117.2	163.2	46	BF	AR
163.2	163.6	0.4	BF	AA
163.6	167	3.4	BF	AA
167	169.5	2.5	BF	*S*
169.5	170.1	0.6	BF	AA
170.1	171	0.9	BF	*S*
171	181.5	10.5	BF	AA
181.5	181.7	0.2	BF	AR
181.7	206.4	24.7	BF	AA
206.4	210.2	3.8	BF	AA
210.2	210.7	0.5	BF	AR
210.7	211.4	0.7	BF	AA
211.4	211.6	0.2	BF	AR
211.6	225.9	14.3	BF	AA
225.9	226	0.1	BF	AR
226	244.1	18.1	BF	AA

Lampiran 7 Hasil analisis AAS

Lab Ref : BKN24-00344
Client Ref. : 240203F
Project/Location: GEOLOGY
Date Received : #######
Date Reported : #######
Status : Final
ANALYTICAL REPORT

DIP : Destroyed In Process
ISF : Insufficient sample
NA : Not Analisis
DTF : Data To Follow
SNR : Sample Not Received
UR : Unreadable

SAMPLE ID	FAA505	FAA505	FAA505	FAA505	FAA505	FAA505	AAS11B	AAS11B	AAS11B	AAS11B
UNIT	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
DET. LIMIT	0,01	0,01	0,01	0,01	0,01	0,01	1	2	4	2
UPPER LIMIT	1000	1000	1000	1000	1000	1000	50	10000	10000	10000
ANALYTE	Au	Au(R)	Au(R3)	Au(R4)	Au(R5)	Au(S)	Ag	Cu	Pb	Zn
LP 1	<0,01						2	66	<4	6
LP 52	0,12						1	<2	15	2
LP 8	0,09						<1	<2	8	<2
LP 47	0,88						3	92	24	4
LP 11	0,76						1	70	31	5
LP 10	0,16						<1	166	21	3
LP 67	0,72						1	41	<4	34
LP 43	0,27					00.26	3	91	31	2
LP 42	0,07						<1	61	21	2
LP 57	<0,01						<1	<2	15	<2
LP 66	0,10						<1	43	20	356
LP 31	1,43						3	128	12	6
LP 34	0,11						<1	123	31	4
LP 38	<0.01	<0.01					<1	31	7	8

Lampiran 8 Peta Lokasi pengamatan

LAMPIRAN 8

PROGRAM STUDI SARJANA TEKNIK PERTAMBANGAN
FAKULTAS TEKNIK
UNIVERSITAS HASANUDDIN
GOWA
2024

PETA LOKASI PENGAMATAN DAERAH BAKAN DAN SEKITARNYA KECAMATAN LOLAYAN KABUPATEN BOLAANG MONGONDOW PROVINSI SULAWESI UTARA

N
W E
S

0 25 50 100 150 200
Meters

SKALA 1 : 1500
Angka grid UTM pada Zona 51 N Speroidal Nasional Indonesia dengan selang jarang 100 meter

DISUSUN OLEH :
AGNES PUTRI YOSY
D111201022

KETERANGAN:

- *VUGGY QUARTZ*
- *SILICIC*
- *ADVANCED ARGILLIC*
- *ARGILLIC*
- TUFA DASITIK
- BREKSI FRATOMAGMATIK
- BREKSI HIDROTERMAL

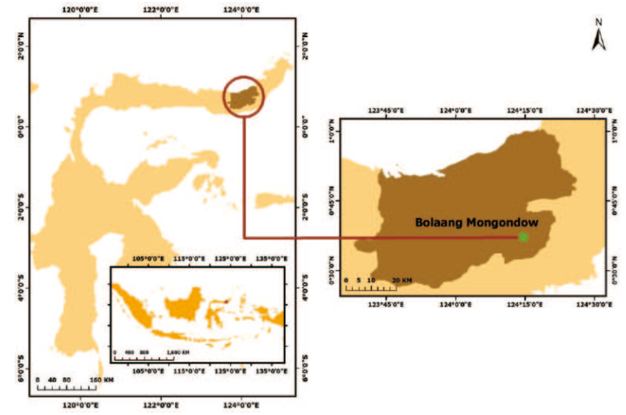
Garis kontur
a. Kontur Mayor
b. Kontur Minor

Kekar

Kontak Satuan

Brekiasi

PETA INDEKS

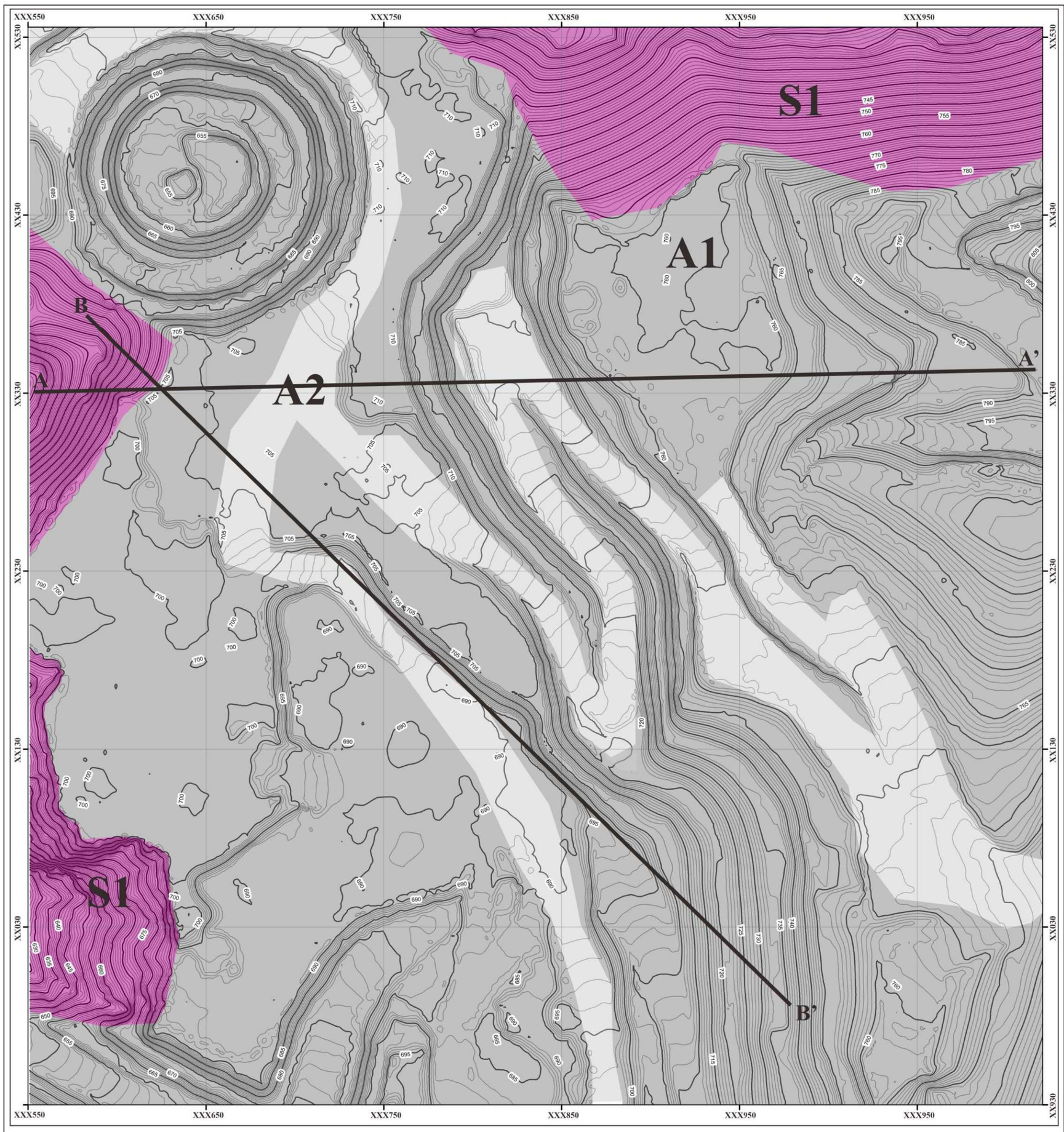


Lampiran 9 Peta geomorfologi

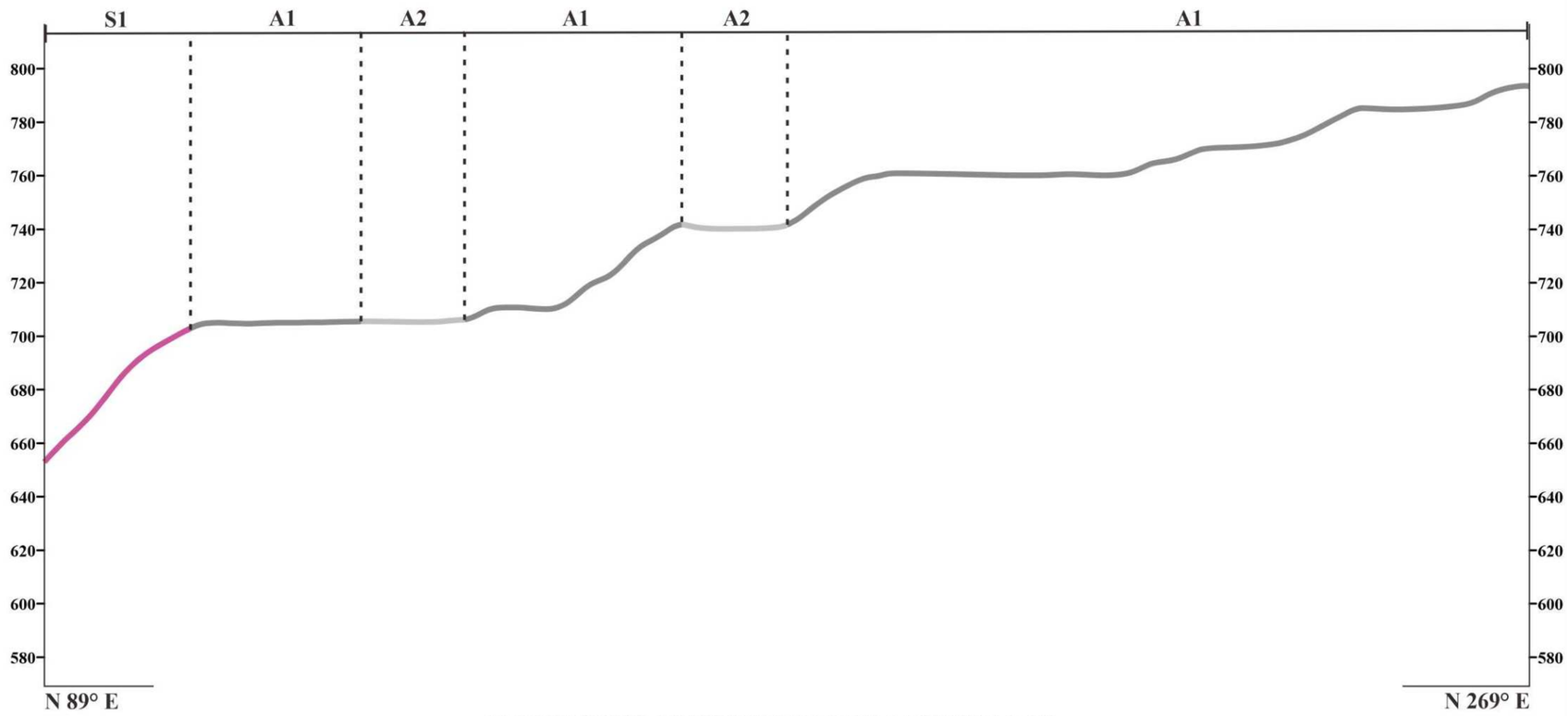
LAMPIRAN 9

PROGRAM STUDI SARJANA TEKNIK PERTAMBANGAN
FAKULTAS TEKNIK
UNIVERSITAS HASANUDDIN
GOWA
2024

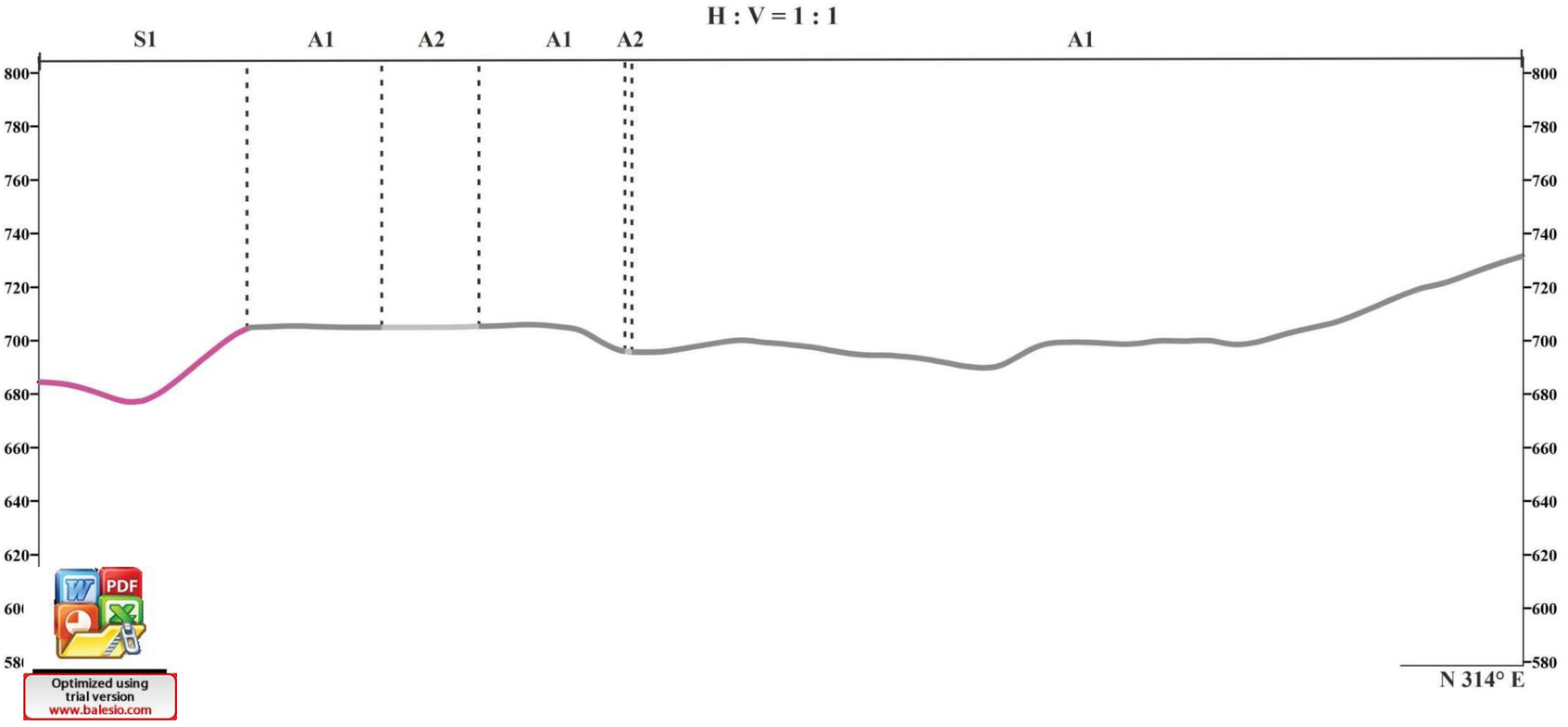
PETA GEOMORFOLOGI DAERAH BAKAN DAN SEKITARNYA KECAMATAN LOLAYAN KABUPATEN BOLAANG MONGONDOW PROVINSI SULAWESI UTARA

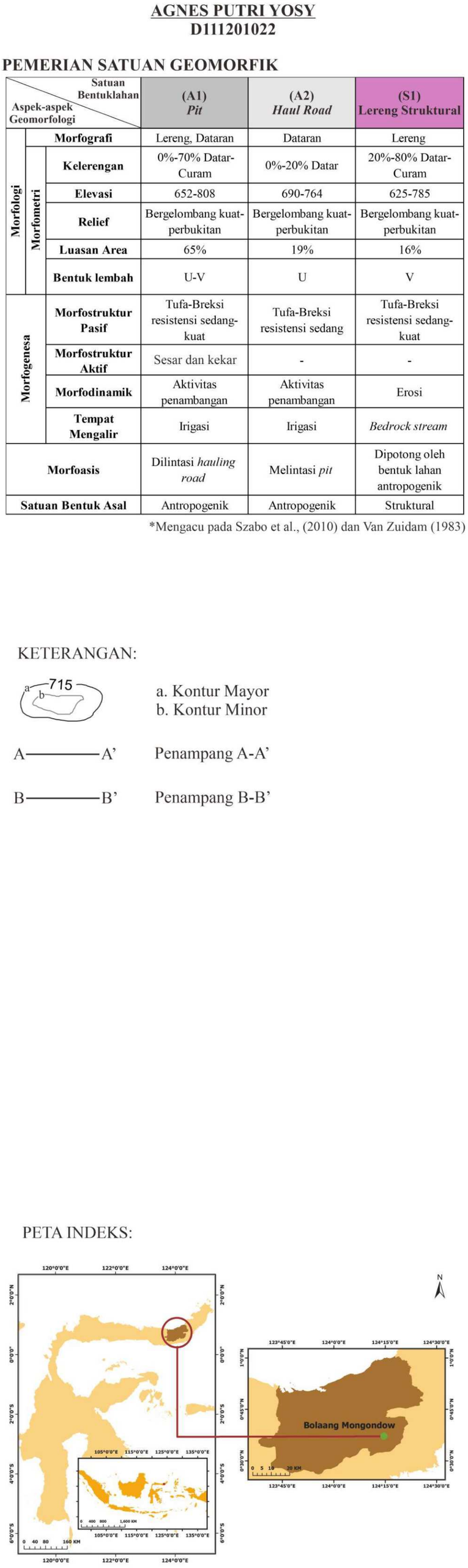


PENAMPANG GEOMORFOLOGI SAYATAN A-A'
SKALA 1 : 1500
H : V = 1 : 1



PENAMPANG GEOMORFOLOGI SAYATAN B-B'
SKALA 1 : 1500
H : V = 1 : 1





SKALA 1 : 1500
Angka grid UTM pada Zona 51 N Speroidal Nasional Indonesia dengan selang jarang 100 meter

DISUSUN OLEH :
AGNES PUTRI YOSY
D111201022

PEMERIAN SATUAN GEOMORFIK

Aspek-aspek Geomorfologi \ Satuan Bentuklahan			(A1) *Pit*	(A2) *Haul Road*	(S1) Lereng Struktural
Morfologi		Morfografi	Lereng, Dataran	Dataran	Lereng
	Morfometri	Kelerengan	0%-70% Datar-Curam	0%-20% Datar	20%-80% Datar-Curam
		Elevasi	652-808	690-764	625-785
		Relief	Bergelombang kuat-perbukitan	Bergelombang kuat-perbukitan	Bergelombang kuat-perbukitan
		Luasan Area	65%	19%	16%
		Bentuk lembah	U-V	U	V
Morfogenesa		Morfostruktur Pasif	Tufa-Breksi resistensi sedang-kuat	Tufa-Breksi resistensi sedang	Tufa-Breksi resistensi sedang-kuat
		Morfostruktur Aktif	Sesar dan kekar	-	-
		Morfodinamik	Aktivitas penambangan	Aktivitas penambangan	Erosi
		Tempat Mengalir	Irigasi	Irigasi	*Bedrock stream*
Morfoasis			Dilintasi *hauling road*	Melintasi *pit*	Dipotong oleh bentuk lahan antropogenik
Satuan Bentuk Asal			Antropogenik	Antropogenik	Struktural

*Mengacu pada Szabo et al., (2010) dan Van Zuidam (1983)

KETERANGAN:

a. Kontur Mayor
b. Kontur Minor

A———A' Penampang A-A'

B———B' Penampang B-B'

PETA INDEKS:

Lampiran 10 Peta geologi

LAMPIRAN 10

PROGRAM STUDI SARJANA TEKNIK PERTAMBANGAN
FAKULTAS TEKNIK
UNIVERSITAS HASANUDDIN
GOWA
2024

PETA GEOLOGI
DAERAH BAKAN DAN SEKITARNYA
KECAMATAN LOLAYAN
KABUPATEN BOLAANG MONGONDOW
PROVINSI SULAWESI UTARA

N
W E
S

0 25 50 100 150 200 Meters

SKALA 1 : 1500
Angka grid UTM pada Zona 51 N Speroidal Nasional Indonesia dengan selang jarang 100 meter

DISUSUN OLEH :
AGNES PUTRI YOSY
D111201022

LEGENDA:

UMUR GEOLOGI			Batuan Gunungapi	Batuan Terobosan
Masa	Zaman	Kala		
KENOZOIKUM	KUARTER	PLEISTOSEN	Tufa Dasitik	Breksi Freatomagmatik, Breksi Hidrotermal
	TERSIER NEOGEN	PLIOSEN		

*Mengacu pada Hardjana (2012)

PEMERIAN:

Satuan Breksi Hidrotermal
Satuan Breksi Hidrotermal menempati 1% dari total luasan daerah penelitian. Satuan ini tersebar secara setempat pada bagian tengah luasan daerah penelitian. Satuan Breksi Hidrotermal tersusun atas breksi hidrotermal monomiktik dan breksi hidrotermal polimiktik dengan tekstur fasies *mozaic* hingga *rotational*. Matriks pada satuan ini berupa mineral hidrotermal seperti silika, hematit, dan goetit. satuan ini mengalami alterasi kuat berupa *silicic*

Satuan Breksi Freatomagmatik
Satuan Breksi Freatomagmatik menempati 55% dari total luasan dari daerah penelitian Satuan ini tersebar pada bagian barat laut hingga selatan luasan daerah penelitian. Satuan Breksi Freatomagmatik tersusun atas breksi freatomagmatik monomiktik dan breksi freatomagmatik polimiktik dengan tekstur fasies *mozaic* hingga *rotational.* breksi freatomagmatik monomiktik tersusun atas fragmen tufa dasitik. breksi diatrem polimiktik tersusun atas fragmen tufa dasitik, andesit, *juvenil clast*, dan diorit. Matriks pada satuan ini tersusun atas r*ock flour material.* Satuan batuan ini mengalami alterasi kuat seperti *vuggy silica*, *silicic*, *advanced argillic*, *argillic*, dan *chloritic* yang ditemukan pada data *logging* pada *hole* MRD-1347.

Satuan Tufa Dasitik
Satuan Tufa Dasitik menempati 44% dari total luasan daerah penelitian. Satuan ini tersebar pada bagian barat dan timurlaut luasan daerah penelitian. satuan tufa dasitik tersusun atas material piroklastik berukuran <2 mm dengan sifat dasitik yang ditunjukkan dengan keberadaan *quartz eye.* Terdiri atas mineral kuarsa,alunit, opak, dan mineral lempung. Satuan ini mengalami alterasi kuat berupa *vuggy silica*, *silicic*, *advanced argillic*, dan *argillic.*

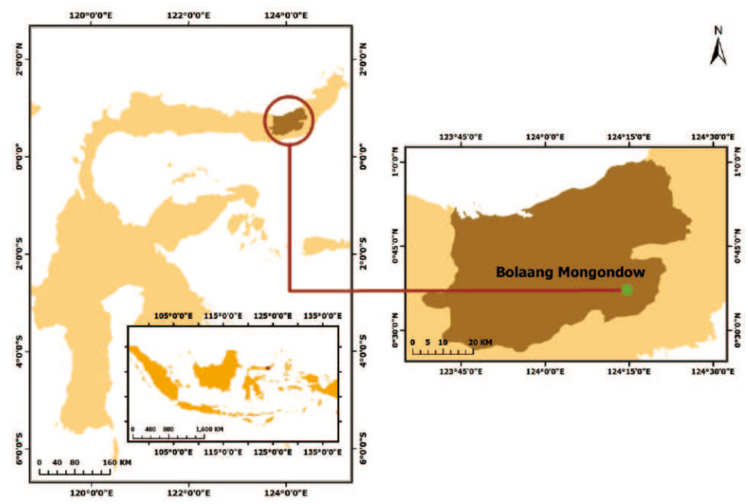
KETERANGAN:

- Garis kontur (a. Kontur Mayor, b. Kontur Minor)
- Penampang A-A’
- Penampang B-B’
- Kekar
- Kontak Satuan
- Titik Bor
- Sesar mendatar kiri (a. Tegas, b. Diperkirakan)
- Sesar mendatar Kanan (a. Tegas, b. Diperkirakan)
- Batas Satuan Batuan

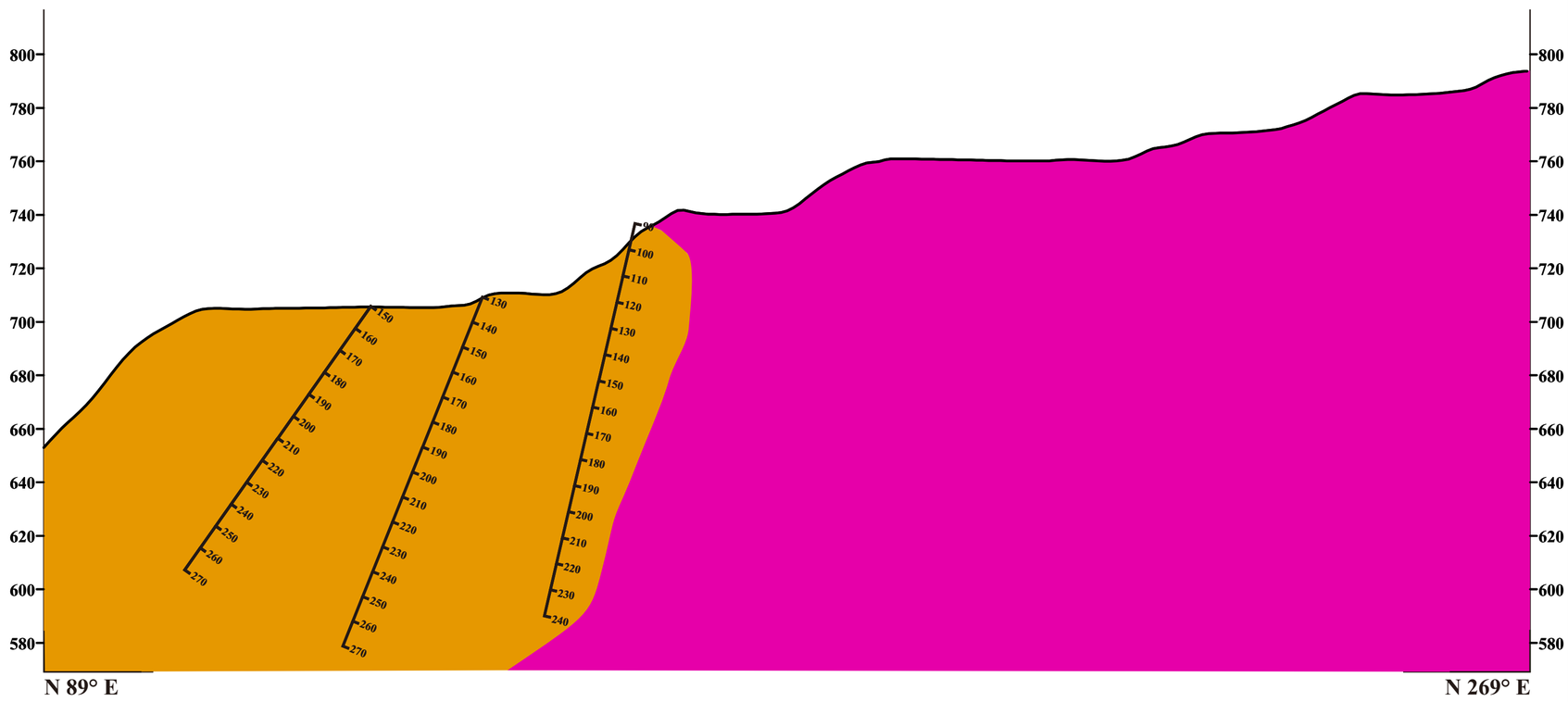
KETERANGAN PENAMPANG:

- Batas Satuan Batuan Diperkirakan
- Sesar mendatar Kanan (a. Blok Menjauh, b. Blok Mendekat)
- Lubang Bor

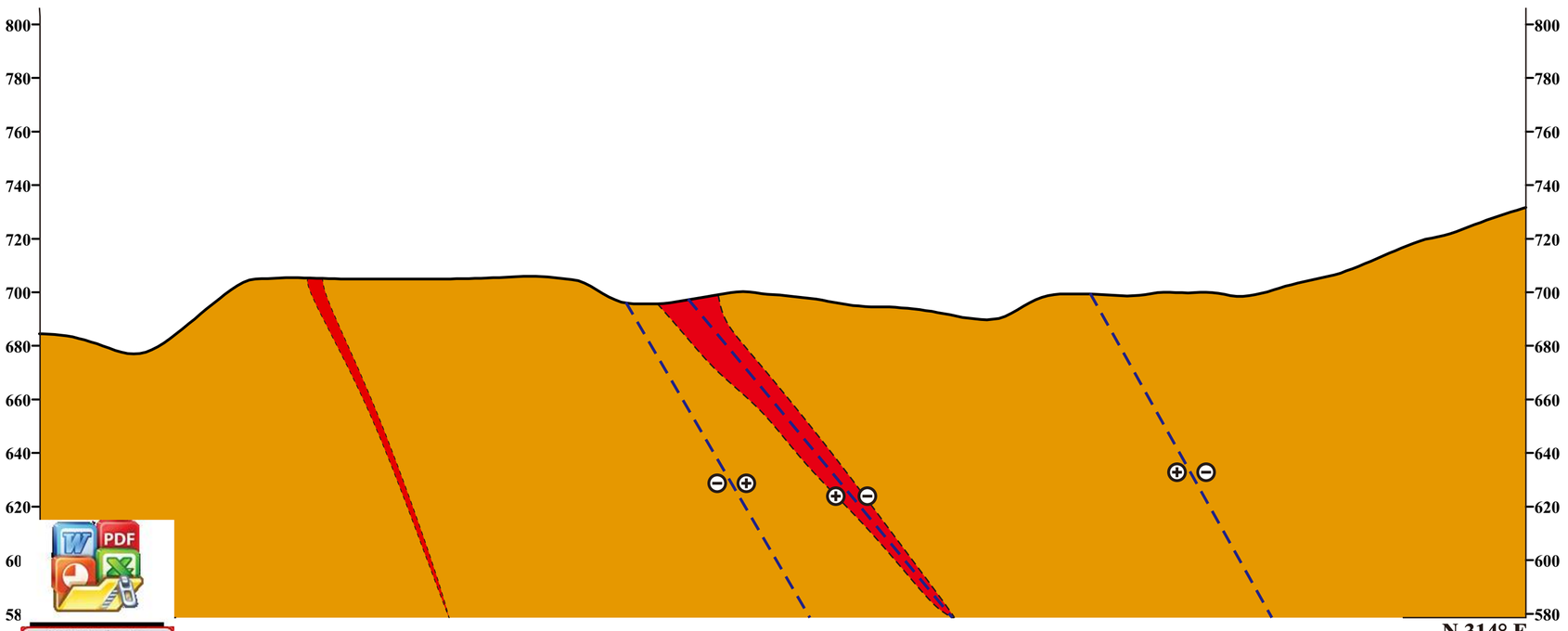
PETA INDEKS:



PENAMPANG GEOLOGI SAYATAN A-A’
SKALA 1 : 1500
H : V = 1 : 1



PENAMPANG GEOLOGI SAYATAN B-B’
SKALA 1 : 1500
H : V = 1 : 1

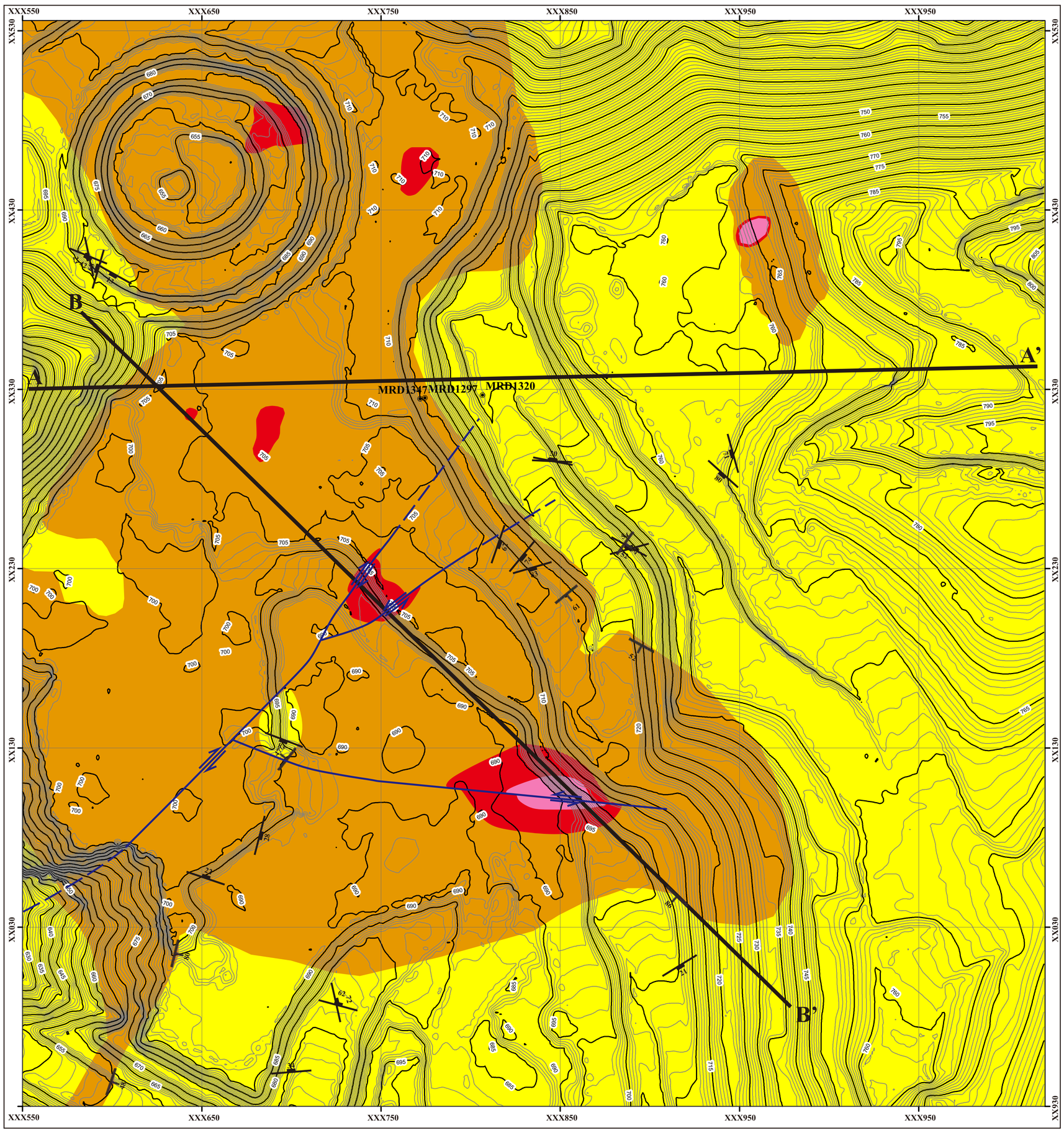


Lampiran 11 Peta alterasi

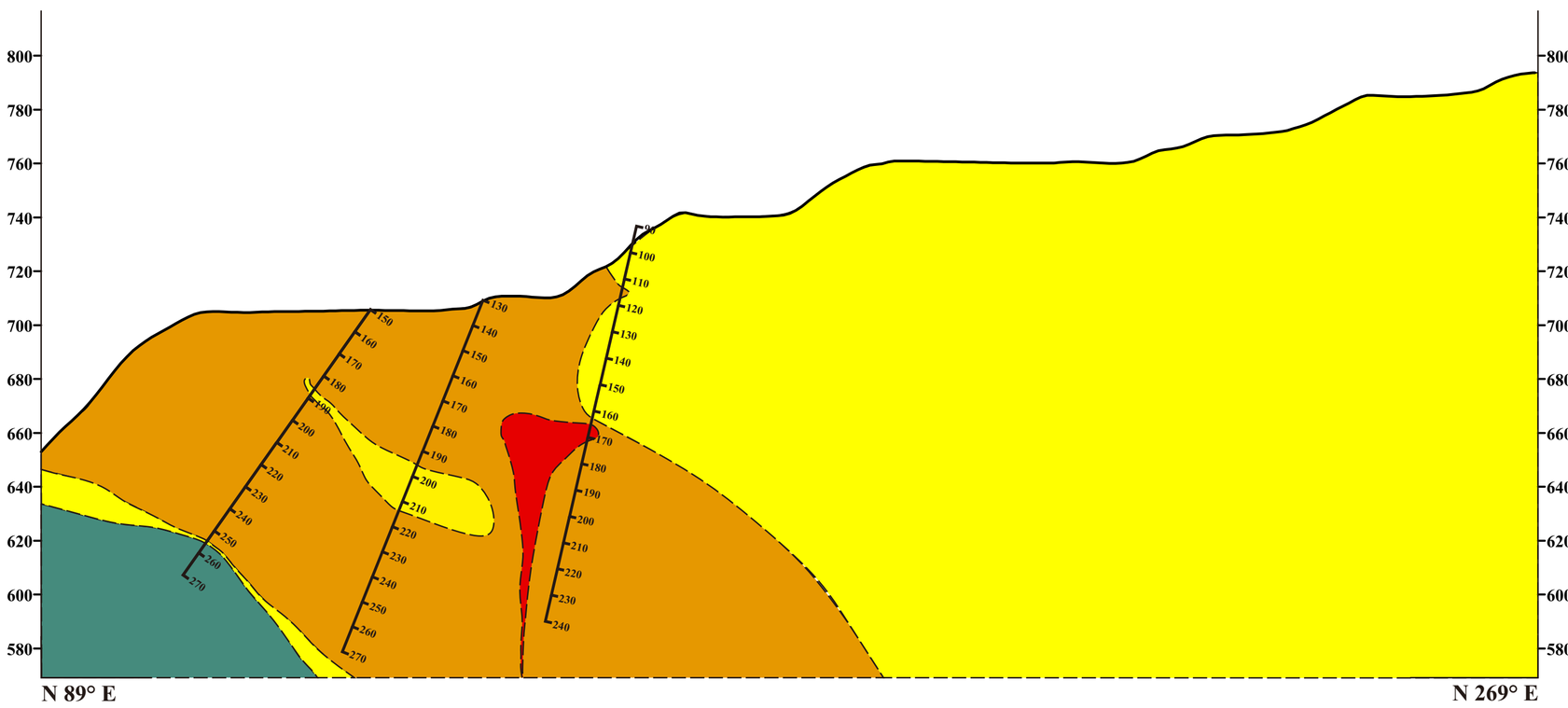
LAMPIRAN 11

PROGRAM STUDI SARJANA TEKNIK PERTAMBANGAN
FAKULTAS TEKNIK
UNIVERSITAS HASANUDDIN
GOWA
2024

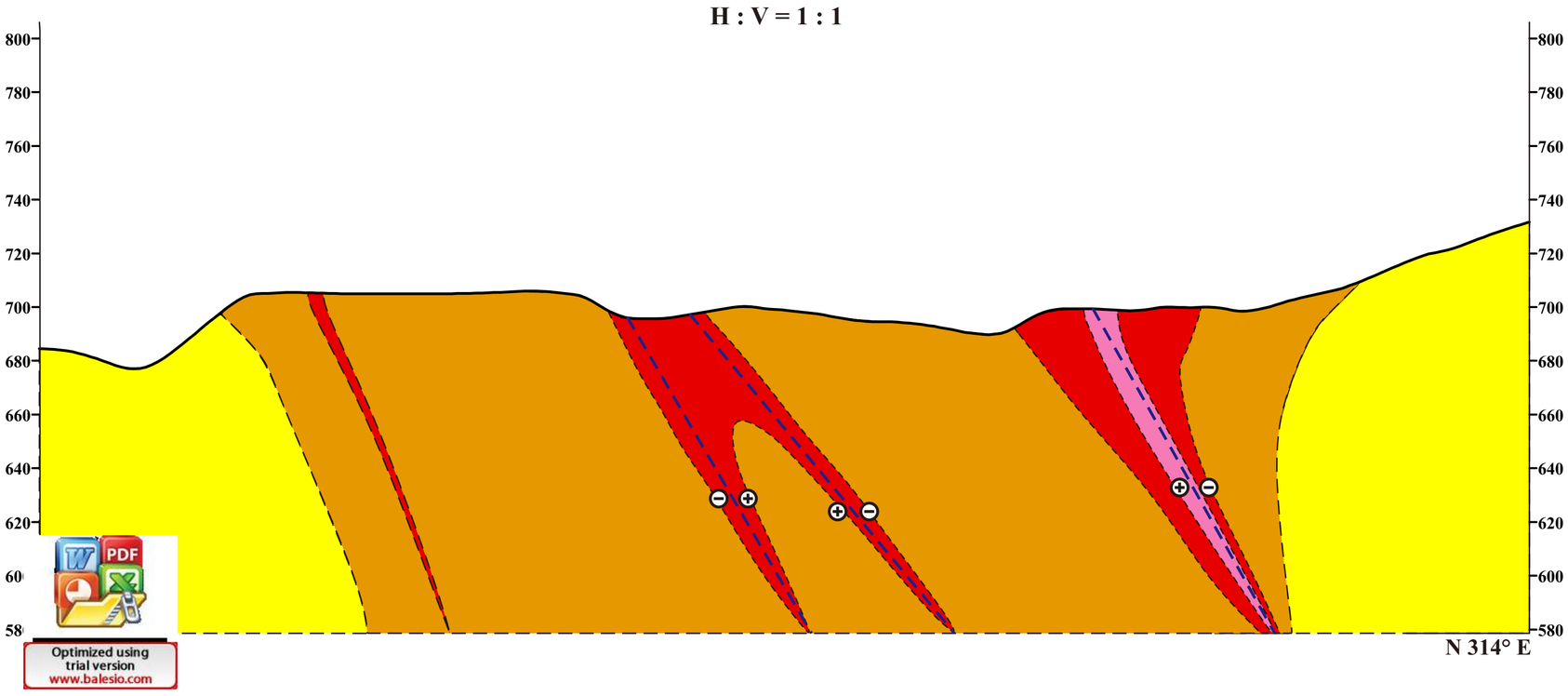
PETA ALTERASI
DAERAH BAKAN DAN SEKITARNYA
KECAMATAN LOLAYAN
KABUPATEN BOLAANG MONGONDOW
PROVINSI SULAWESI UTARA



PENAMPANG ALTERASI SAYATAN A-A'
SKALA 1 : 1500
H : V = 1 : 1



PENAMPANG ALTERASI SAYATAN B-B'
SKALA 1 : 1500
H : V = 1 : 1



N
W E
S

0 25 50 100 150 200 Meters

SKALA 1 : 1500
Angka grid UTM pada Zona 51 N Speroidal Nasional Indonesia dengan selang jarang 100 meter

DISUSUN OLEH :
AGNES PUTRI YOSY
D111201022

PEMERIAN ALTERASI:

Zona Alterasi *Vuggy Quartz*
Zona Alterasi *Vuggy quartz* menempati 3% dari total luasan daerah penelitian. alterasi ini tersebar setempat pada bagian timur luasan daerah penelitian. Zona alterasi ini tersusun atas himpunan mineral *quartz±alunite* dengan tekstur *vuggy* >10%. Zona alterasi ini ditemuka pada litologi breksi freatomagmatik dan tufa dasitik. alterasi ini merupakan pusat dari zona alterasi dan mengandung mineral bijih emas yang tinggi.

Zona Alterasi *Silicic*
Zona Alterasi *Silicic* menempati 10% dari total luasan daerah penelitian. Alterasi ini tersebar setempat pada bagian tengah luasan daerah penelitian. Zona alterasi ini tersusun atas himpunan mineral *quartz±alunite* dengan tekstur masif dan intensitas *vuggy* <10%. Zona alterasi ini ditemukan pada litologi breksi hidrotermal, breksi freatomagmatik, dan tufa dasitik. Kandungan mineral bijih emas pada alterasi ini termasuk ekonomis.

Zona Alterasi *Advanced Argillic*
Zona Alterasi *Advanced Argillic* menempati 22% dari total luasan daerah penelitian. Alterasi ini tersebar secara menyebar pada bagian barat luasan daerah penelitian. Zona ini tersusun atas himpinan mineral *quartz±alunite±kaolinite±pyrophylite.* Zona alterasi ini ditemukan pada litologi breksi fratomagmatik dan tufa dasitik. Kandungan mineral bijih pada alterasi ini cukup ekonomis.

Zona Alterasi *Argillic*
Zona Alterasi *Argillic* menempati 55% dari total luasan daerah penelitian. alterasi ini menyebar barat dan timur luasan daerah penelitian. Zona ini tersusun atas himpunan mineral *illite±montmorilonite±kaolinite±dickite±halloysite.* Zona alterasi ini ditemukan pada litologi breksi fratomagmatik dan tufa dasitik. Kandungan mineral bijih emas pada alterasi ini tidak ekonomis.

Zona Alterasi *Propylitic*
Zona Akterasi *Propylitic* ditemukan pada *borehole* MRD-1347 pada kedalaman 255-270 meter pada bagian barat luasan daerah peneltian. pada zona alterasi ini tersusun atas mineral klorit, silika dan epidot. Zona alterasi ini ditemukan pada litologi breksi freatomagmatik.

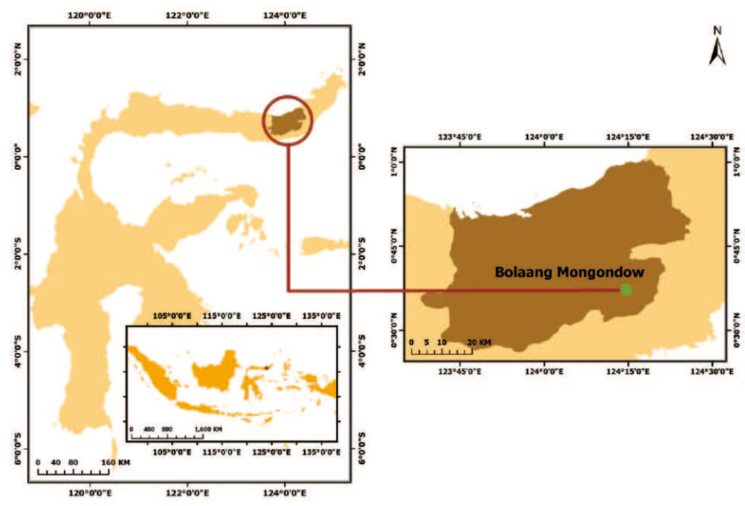
KETERANGAN:

- Garis kontur (a. Kontur Mayor, b. Kontur Minor)
- Titik Bor
- Penampang A-A'
- Sesar mendatar kiri (a. Tegas, b. Diperkirakan)
- Penampang B-B'
- Sesar mendatar Kanan (a. Tegas, b. Diperkirakan)
- Kekar
- Batas Satuan Alterasi
- Kontak Satuan

KETERANGAN PENAMPANG:

- Batas Satuan Alterasi Diperkirakan
- Sesar mendatar Kanan (a. Blok Menjauh, b. Blok Mendekat)
- Lubang Bor

PETA INDEKS:



Lampiran 12 Peta mineralisasi

LAMPIRAN 12

PROGRAM STUDI SARJANA TEKNIK PERTAMBANGAN
FAKULTAS TEKNIK
UNIVERSITAS HASANUDDIN
GOWA
2024

PETA MINERALISASI DAERAH BAKAN DAN SEKITARNYA KECAMATAN LOLAYAN KABUPATEN BOLAANG MONGONDOW PROVINSI SULAWESI UTARA

N
W E
S

0 25 50 100 150 200 Meters

SKALA 1 : 1500

Angka grid UTM pada Zona 51 N Speroidal Nasional Indonesia dengan selang jarang 100 meter

DISUSUN OLEH :
AGNES PUTRI YOSY
D111201022

KETERANGAN:

- **<0,1 ppm Au**
- **0,1 - 0,3 ppm Au**
- **0,3 - 1,0 ppm Au**
- **> 1,0 ppm Au**

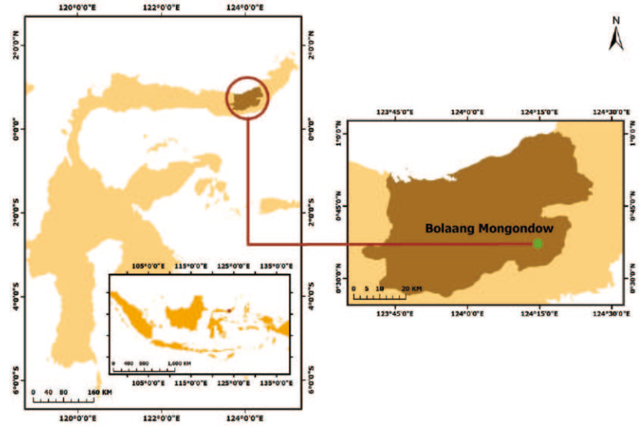
Garis kontur
a. Kontur Mayor
b. Kontur Minor

Kekar

Kontak Satuan

Sesar mendatar kiri
a. Tegas
b. Diperkirakan
Sesar mendatar Kanan
a. Tegas
b. Diperkirakan

PETA INDEKS:



Lampiran 13 Kartu konsultasi tugas akhir

Lampiran B 10

Kartu Konsultasi Tugas Akhir

JUDUL: STUDI ALTERASI DAN MINERALISASI ENDAPAN EPITERMAL DI LOKASI IUP PT X KABUPATEN BOLAANG MONGONDOW, PROVINSI SULAWESI UTARA

(Konsultasi minimal 8 kali)

TANGGAL	MATERI KONSULTASI	PARAF DOSEN
28/04/2014	- Judul - BAB I - BAB II	
30/04/2014	- Perbaikan latar belakang - " tujuan - " tinjauan pustaka	
6/05/2014	- Analisis petrografi - Peta geologi regional - Penulisan pada gambar - Metode penelitian	

TANGGAL	MATERI KONSULTASI	PARAF DOSEN
27/05/24	- Analisis petrografi - BAB III - Analisis Mineragrafi	
31/05/24	- Daftar pustaka - Pencampang geologi - Catatan lokasi	
4/06/24	- Analisis petrografi - Analisis mineragrafi	
7/06/24	- Analisis XRD - Analisis ASD	
10/06/24	- Analisis mineragrafi	

TANGGAL	MATERI KONSULTASI	PARAF DOSEN
14/06/24	- Penulisan Azimuth - Lampiran - Italic pada kecuali asing	
18/06/24	- penambahan subbab - BAB IV	
27/06/24	- BAB IV - BAB V - Daftar pustaka	
18/07/24	- Perbaikan Geomorfologi - perbaikan gambar pada hasil - perbaikan kesimpulan	

an: Lembar konsultasi asli dilampirkan pada satu dokumen skripsi.