DAFTAR PUSTAKA

Ahmad, W., 2005. *Laterite: Mine Geology, Exploration Method, Ore Processing, Resource Estimation and Project Development*. PT. International Nickel Indonesia: Sorowako, South Sulawesi. *(Unpublish Training Manual)*.

Ahmad, W., 2006. *Laterite: Fundamentals of Chemistry, Mineralogy, Weathering Process and Laterite Formation*. PT. International Nickel Indonesia: Sorowako, South Sulawesi. *(Unpublish Training Manual)*.

Boldt, J.R., 1967. *The Winning of Nickel Its Geology, Mining, and Extractive Metallurgy*, Toronto.

Brand, N.W., Butt, C.R.M., Elias, M., 1998. *Nickel Laterites: Classification and features*. Journal of Australian Geology and Geophysics, 17(4), pp. 81-88.

Brimhall, G.H. and Dietrich, W.E., 1987. *Constitutive mass-balance relations between chemical composition, volume, density, porosity and strain in metasomatic hydrochemical systems: Results on weathering and pedogenesis*. Geochimica et Cosmochimica Acta, 51, pp. 567–587.

Butt, C.R.M. and Cluzel, D., 2013. *Nickel Laterite Ore Deposite: Weathered Serpentinites*. Elements, Vol. 9, pp. 123-128.

Campodonico, V., Pasquini, A., Lecomte, K., Garcia, M., Depetris, P., 2019. *Chemical weathering in subtropical basalt-derived laterites: A mass balance interpretation*. Catena, Volume 173, pp. 352-366.

Chaussier, J B and Morer, J., 1987. *Mineral Prospecting Manual*. North Oxford Academic Publishers Ltd. London.

Cullity, B.D, 1956. *Element of X-Ray Diffraction*. Addison-Wesley Publishing Company, Inc.

Fu, W., Yang, J., Yang, M., Pang, B., Liu, X., Niu, H., Huang, X., 2014. *Mineralogical and geochemical characteristics of a serpentine-derived laterite profile from east Sulawesi, Indonesia: Implications for the lateritization process and Ni Supergene enrichment in the tropical rainforest*. Journal of Asian Earth Sciences 93 (2014) pp 74-88.

Golightly, J.P., 1979. *Geology of Soroako nickeliferous laterite deposits*. In: Evans, D.J.I., Shoemaker, R.S., Veltman, H. (Eds.), International Laterite Symposium. AIME, New York, pp. 38–56.

Golightly, J.P., 1981. *Nickeliferous laterite deposits*. In: Economic Geology, 75th Anniversary Volume, pp. 710–735.

Golightly, J.P., 2010. *Progress in understanding the evolution of nickellaterites*. In: Goldfarb RJ, Marsh EE, Monecke T (eds) The Challenge ofFinding New Mineral Resources: GlobalMetallogeny, Innovative Exploration and New Discoveries Volume II. Society of Economic Geologists Special Publication 15, pp. 451-475.

Kadarusman, A., Miyashitab, S., Maruyamaa, S., Parkinsonc, C.D., Ishikawad, A., 2004. *Petrology, geochemistry and paleogeographic reconstruction of the East Sulawesi Ophiolite, Indonesia*. Tectonophysics 392, pp. 55–83.

Lin, F.C. & Clemency, C.V., 1981. *The dissolution kinetics of brucite, antigorite, talc and phlogopite at room temperature and pressure*. American Mineralogist, 66.

Moore, D. M. & Reynolds, R. C., 1997. *X-Ray Diffraction and the Identification and Analysis of Clay Minerals*. 2nd Edition XVIII+ 378 pp. New York: Oxford University Press.

Simandjuntak, T.O, 1986. *Sedimentology and Tectonic of the Collision Complex in the East Arm of Sulawesi, Indonesia*. PhD thesis, University of London, London, (unpubl.), 374 p.

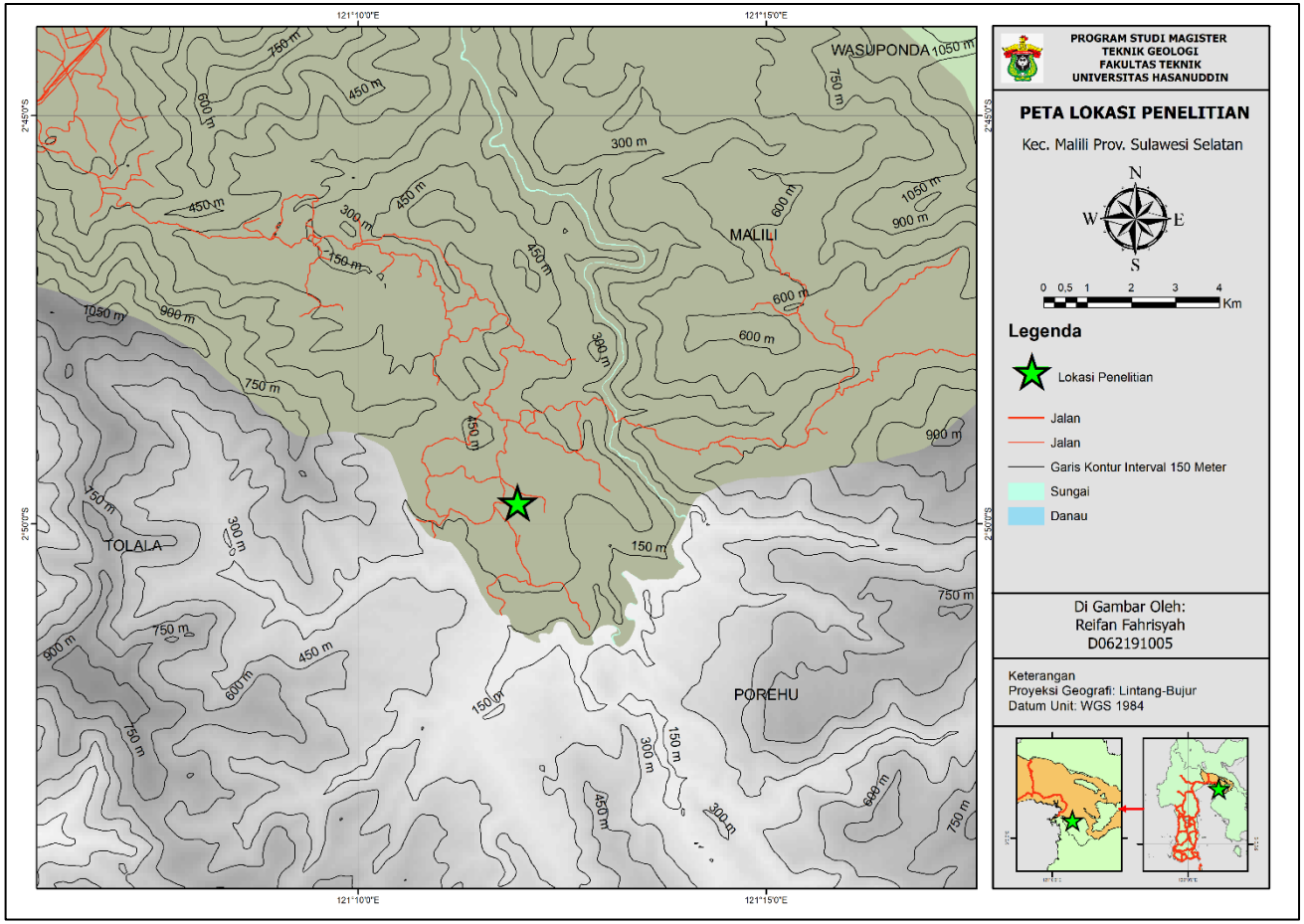
Sufriadin, Idrus, A., Pramumijoyo, S., Warmada, I.W., Nur, I. and Imai, A., 2011. *Mineralogical transformation and element distribution in two weathering profiles of the Soroako nickel laterite mining district, Sulawesi, Indonesia*. International Symposium on Earth Science and Technology, 2011, pp. 447–454.

Traore, D. Beauvais, A. Chabaux, F. Peiffert, C. Parisot, J.C. Ambrosi., J.P. Colin, F., 2008. *Chemical and physical transfers in an ultramafic rock wathering profile: Part 1. Supergene dissolution of Pt-bearing chromite*. American Mineralogist, pp. 93.

Traore, D., Beauvais, A., Auge, T., Parisot, J.C., Colin, F. and Cathelineau, M., 2008. *Chemical and physical transfers in an ultramafic rock weathering profile: part 2. Dissolution vs. accumulation of platinum group minerals*. American Mineralogist, 93, pp. 31–38.

LAMPIRAN

Lampiran A
Peta Lokasi Penelitian



Lampiran B
Hasil Pengolahan Data XRD

Sampel BR-06

Match! Phase Analysis Report

Sample: BR-06 (5-70)

Sample Data

File name	BR-06.RAW
File path	C:/Users/reifa/Desktop/Data XRD Reifan/BR-06
Data collected	May 24, 2021 14:03:24
Data range	5.120° - 70.120°
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
2theta correction	0.12°
Radiation	X-rays
Wavelength	1.540600 Å

Matched Phases

Index	*Amount (%)*	*Name*	*Formula sum*
A	80.9	Lizardite-1T	H6 Mg3 O9 Si2
B	7.7	Iron diiron(III) oxide Magnetite	Fe3 O4
C	7.0	Cristobalite	O2 Si
D	4.4	Orthopyroxene	Al0.236 Ca0.01 Fe0.967 Mg0.923 Mn0.016 O6 Si1.848
	5.7	*Unidentified peak area*	

Amounts calculated by RIR (Reference Intensity Ratio) method

Elemental composition of sample (identified crystalline phases only)

Element	*Amount (weight %)*
O	51.00%
Mg	21.99%
Si	21.55%
Fe	7.53%
H	1.75%
LE (sum)	*52.75%*

Matching entry details

A: Lizardite-1T (80.9 %)*

Formula sum	H6 Mg3 O9 Si2
Entry number	96-900-1779
Figure-of-Merit (FoM)	0.722047*
Total number of peaks	114
Peaks in range	27
Peaks matched	15
Intensity scale factor	1.32*
Space group	P 3 1 m
Crystal system	trigonal (hexagonal axes)
Unit cell	a= 5.3267 Å c= 7.2539 Å
I/Ic	1.34
Calc. density	2.600 g/cm³
Reference	Gregorkiewitz M., Lebech B., Mellini M., Viti C., "Hydrogen positions and thermal expansion in lizardite-1T from Elba: Alow-temperature study using Rietveld refinement of neutron diffraction dataT = 8 K", American Mineralogist **81**, 1111-1116 (1996)

B: Iron diiron(III) oxide Magnetite (7.7 %)*

Formula sum	Fe3 O4
Entry number	96-722-8111
Figure-of-Merit (FoM)	0.646416*
Total number of peaks	32
Peaks in range	10
Peaks matched	5
Intensity scale factor	0.54*
Space group	F d -3 m
Crystal system	cubic
Unit cell	a= 8.3600 Å
I/Ic	5.78
Meas. density	5.200 g/cm³
Calc. density	5.264 g/cm³
Reference	El Mendili Y., Abdelouas A., Bardeau J.-F., "Insight into the mechanism of carbon steel corrosion under aerobic andanaerobic conditions", Physical Chemistry and Chemical Physics **15(23)**, 9197-9204 (2013)

C: Cristobalite (7.0 %)*

Formula sum	O2 Si
Entry number	96-901-5792
Figure-of-Merit (FoM)	0.695097*
Total number of peaks	130
Peaks in range	26
Peaks matched	8
Intensity scale factor	0.38*
Space group	P 41 21 2
Crystal system	tetragonal
Unit cell	a= 4.9080 Å c= 6.7840 Å
I/Ic	4.39
Calc. density	2.442 g/cm³
Reference	Dera P., Lazarz J. D., Prakapenka V. B., Barkley M., Downs R. T., "New insights into the high-pressure polymorphism of SiO2 cristobaliteNote: P = 0.6 GPa", Physics and Chemistry of Minerals **38**, Online-first (2011)

D: Orthopyroxene (4.4 %)*

Formula sum	Al0.236 Ca0.01 Fe0.967 Mg0.923 Mn0.016 O6 Si1.848
Entry number	96-901-0429
Figure-of-Merit (FoM)	0.622012*
Total number of peaks	500
Peaks in range	151
Peaks matched	45
Intensity scale factor	0.03*
Space group	P b c a
Crystal system	orthorhombic
Unit cell	a= 18.1427 Å b= 8.7460 Å c= 5.1716 Å
I/Ic	0.55
Calc. density	3.755 g/cm³
Reference	Nestola F., Ballaran T. B., Balic-Zunic T, Secco L., Dal Negro A., "The high-pressure behavior of an Al- and Fe-rich natural orthopyroxeneSample: P = 3.947 GPa", American Mineralogist **93**, 644-652 (2008)

(*)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'.

Candidates

Name	*Formula*	*Entry No.*	*FoM*
	Ni0.493 Ti0.507	96-901-6228	0.6769
	Ga Ru	96-152-3921	0.6687
	Al Cu2 Ti	96-154-1232	0.6647
	Ga Ni2 Sc	96-152-3491	0.6620
(Co Ni) Mn Sn	Co Mn Ni Sn	96-152-5416	0.6619
	Mn Ni2 Sb	96-153-8637	0.6500
	Mn Ni2 Sb	96-153-9555	0.6488
	Ni0.493 Ti0.507	96-901-4020	0.6465
	Cu5 Zn8	96-430-7127	0.6416
austenite	Ni Ti	96-110-0133	0.6403
(N H4) (Cl O2)	Cl H4 N O2	96-231-0858	0.6365
	Cu5.31 Zn7.69	96-430-7126	0.6307
H K3 (Ti O)4 (Si O4)3 (H2 O)4	H9 K3 O20 Si3 Ti4	96-153-3728	0.6279
	Al F6 K3	96-430-3320	0.6273
Ti1.25 Fe Sb	Fe Sb Ti1.25	96-153-1835	0.6267
Copper(I) oxide (Cuprite)	Cu2 O	96-101-0942	0.6233
Copper(I) oxide (Cuprite)	Cu2 O	96-101-0964	0.6218
Ba2 Nb (Ca0.733 Nb0.267) O5.9	Ba2 Ca0.733 Nb1.267 O5.9	96-153-1976	0.6210
	C16 H23 Ni P S4 W	96-210-1799	0.6172
H2 Os3 Re2 (C O)20	C20 H2 O20 Os3 Re2	96-434-4214	0.6160
Barium potassium sodium bismuth oxide (3.04/0.96/0.63/3.37/12)	Ba3.04 Bi3.37 K0.96 Na0.63 O12	96-100-8912	0.6142
Barium Mercury Copper Oxide (2/1/1/4.1)	Ba2 Cu Hg O4.1	96-152-0217	0.6137
	Ba1.2 Ca0.8 La Nb O6	96-703-6922	0.6130
Pyroxene-ideal	Mg O3 Si	96-900-3436	0.6128
	Er Ga2	96-152-5486	0.6124
	C14 H20 Br2 Se2 Si2	96-150-2962	0.6118
	Ga2 Tb	96-152-7396	0.6115
Na1.13 K0.125 (Ba Sr Pb)0.0835 Ca0.75 Fe4.42 Mn1.42 (Li Mg)0.25 Zn0.42 Al0.5(P6 O23.82 F1.16)	Al0.5 Ba0.0835 Ca0.75 F1.16 Fe4.42 K0.125 Li0.25 Mg0.25 Mn1.42 Na1.13 O23.82 P6 Pb0.0835 Sr0.0835 Zn0.42	96-153-0217	0.6111
Mercury bismuth barium copper oxide (0.8/0.2/2/1/4.28)	Ba2 Bi0.22 Cu Hg0.78 O4.28	96-100-1763	0.6093
	Cu5.59 Zn7.41	96-430-7125	0.6077
	Al K O2	96-210-5204	0.6066
Mercury barium copper oxide (1/2/1/4.01)	Ba2 Cu Hg O4.01	96-100-8822	0.6063
Mercury barium copper oxide (1/2/1/4.27)	Ba2 Cu Hg O4.27	96-100-8821	0.6061
	La2 Mo2 O9	96-400-0584	0.6059
Hg Ba2 Cu O4.069	Ba2 Cu Hg O4.069	96-152-0819	0.6052
Mercury barium copper oxide (1/2/1/4.27)	Ba2 Cu Hg O4.27	96-100-8823	0.6044
Mercury barium copper oxide (1/2/1/4.34)	Ba2 Cu Hg O4.34	96-100-8820	0.6036
Hematite-proto	Fe1.76 H0.06 O3	96-900-2161	0.6029
Mercury barium copper oxide (1/2/1/4.24)	Ba2 Cu Hg O4.24	96-100-8824	0.6027
	C16 Fe5 O15	96-434-5896	0.6027

Mercury barium copper oxide (1/2/1/4.31)	Ba2 Cu Hg O4.31	96-100-8825	0.6014
Protopyroxene	Li0.23 Mg1.54 O6 Sc0.23 Si2	96-900-2038	0.6012
Cobaltkoritnigite	As Co H3 O5	96-901-2337	0.6012
Sodium hydrogensulfide - at 473K	H Na S	96-101-0904	0.6004
	Na S	96-901-6082	0.6004
Pyroxene-ideal	Mg O3 Si	96-900-3383	0.5988
Forsterite	Fe0.45 Mg1.55 O4 Si	96-901-0776	0.5767
Forsterite	Ca0.01 Fe0.35 Mg1.64 O4 Si	96-900-0315	0.5741
Forsterite	Mg2 O4 Si	96-901-3097	0.5707
Diopside	Al0.121 Ca0.828 Cr0.023 Fe0.072 Mg0.89 Mn0.001 Na0.102 O6 Si1.962 Ti0.002	96-900-5236	0.5634
Enstatite	Al0.14 Ca0.012 Fe0.24 Mg1.66 O6 Si1.94	96-900-6442	0.5605
Pyroxene-ideal	Li O6 Si2 V	96-900-3405	0.5586
and 565 others...			

Search-Match

Settings

Reference database used	COD-Inorg 2020.12.16
Automatic zeropoint adaptation	Yes
Downgrade entries with low scaling factors	Yes
Minimum figure-of-merit (FoM)	0.60
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

Criteria for entries added by user

Reference:

Entry number:

96-100-0008;96-100-0009;96-100-0010;96-100-0011;96-100-0012;96-100-0013;96-100-0014;96-100-0015;96-100-0016;96-100-0017;96-101-1048;96-101-1058;96-110-0019;96-154-4667;96-154-4668;96-154-4670;96-900-0332;96-900-0333;96-900-0334;96-900-0335;96-900-0336;96-900-0507;96-900-0792;96-900-0798;96-900-0799;96-900-0800;96-900-0801;96-900-0802;96-900-1304;96-900-1305;96-900-1306;96-900-1307;96-900-1308;96-900-1333;96-900-1334;96-900-1335;96-900-1336;96-900-1337;96-900-1338;96-900-1339;96-900-1340;96-900-1741;96-900-2719;96-900-2722;96-900-2723;96-900-4023;96-900-4024;96-900-4025;96-900-4026;96-900-4027;96-900-4028;96-900-4029;96-900-4210;96-900-4211;96-900-4212;96-900-4213;96-900-4214;96-900-4312;96-900-4313;96-900-4314;96-900-4315;96-900-4316;96-900-4317;96-900-4318;96-900-4319;96-900-4320;96-900-4321;96-900-4322;96-900-4554;96-900-4602;96-900-4954;96-900-4955;96-900-4956;96-900-4997;96-900-4998;96-900-4999;96-900-5000;96-900-5002;96-900-5003;96-900-5004;96-900-5005;96-900-5006;96-900-5007;96-900-5008;96-900-5009;96-900-5010;96-900-5011;96-900-5183;96-900-5184;96-900-5185;96-900-5186;96-900-5187;96-900-5235;96-900-5236;96-900-5277;96-900-5278;96-900-5279;96-900-5280;96-900-5281;96-900-5311;96-900-5334;96-900-5335;96-900-5336;96-900-5337;96-900-5338;96-900-5339;96-900-5340;96-900-5341;96-900-5560;96-900-5561;96-900-5678;96-900-5679;96-900-5680;96-900-5681;96-900-5682;96-900-5683;96-900-5703;96-900-5704;96-900-5705;96-900-5706;96-900-5707;96-900-6145;96-900-6146;96-900-6147;96-900-6148;96-900-6149;96-900-6150;96-900-9602;96-901-4599;96-100-0048;96-101-1019;96-154-5543;96-154-8550;96-154-8551;96-154-8552;96-900-1179;96-900-1221;96-900-1594;96-900-1595;96-900-1596;96-900-1597;96-900-1598;96-900-1599;96-900-1600;96-900-1601;96-900-1602;96-900-1642;96-900-1643;96-900-1644;96-900-1645;96-900-1646;96-900-1700;96-900-1701;96-900-2711;96-900-2712;96-900-2713;96-900-2714;96-900-2715;96-900-2716;96-900-2717;96-900-4030;96-900-4031;96-900-4032;96-900-4033;96-900-4034;96-900-4118;96-900-4119;96-900-4957;96-900-4958;96-900-5542;96-900-5543;96-900-5544;96-900-5545;96-900-5589;96-900-5590;96-900-5776;96-900-5777;96-900-6338;96-900-6339;96-900-6340;96-900-6341;96-900-6342;96-900-6343;96-900-6428;96-900-6429;96-900-6430;96-900-6431;96-900-6432;96-900-6433;96-900-6434;96-900-6435;96-900-6436;96-900-6437;96-900-6438;96-900-6439;96-900-6440;96-900-6441;96-900-6442;96-900-6443;96-900-8078;96-900-8165;96-901-0242;96-901-0872;96-901-0873;96-901-0874;96-901-0888;96-901-0889;96-901-0890;96-901-0891;96-901-0892;96-901-0893;96-901-0894;96-901-0895;96-901-0896;96-901-0897;96-901-0898;96-901-0899;96-901-1582;96-901-3659;96-901-4118;96-901-4448;96-901-4536;96-901-4861;96-901-4978;96-901-4984;96-901-5810;96-901-6053;96-901-6154;96-901-6258;96-901-6266;96-901-6573;96-154-4672;96-201-4615;96-201-9640;96-201-9641;96-201-9642;96-201-9643;96-900-0150;96-900-0598;96-900-1209;96-900-1210;96-900-1211;96-900-1212;96-900-1213;96-900-1214;96-900-1215;96-900-1216;96-900-1217;96-900-1218;96-900-1219;96-900-1220;96-900-1578;96-900-1750;96-900-1751;96-900-2031;96-900-2032;96-900-2033;96-900-2034;96-900-2035;96-900-2036;96-900-2037;96-900-2038;96-900-2481;96-900-2482;96-900-2483;96-900-2484;96-900-2485;96-900-2486;96-900-2908;96-900-2909;96-900-2910;96-900-2911;96-900-2912;96-900-2913;96-900-2914;96-900-2915;96-900-2916;96-900-2917;96-900-2918;96-900-2919;96-900-2920;96-900-2921;96-900-2922;96-900-2923;96-900-2924;96-900-2925;96-900-2926;96-900-2927;96-900-2928;96-900-2929;96-900-2930;96-900-2931;96-900-2932;96-900-2933;96-900-2934;96-900-2935;96-900-2936;96-900-2937;96-900-2938;96-900-2939;96-900-2940;96-900-2941;96-900-2942;96-900-2943;96-900-2944;96-900-2945;96-900-2946;96-900-2947;96-900-2948;96-900-2949;96-900-2950;96-900-2951;96-900-2952;96-900-2953;96-900-2954;96-900-2955;96-900-2956;96-900-2957;96-900-2958;96-900-2959;96-900-2960;96-900-2961;96-900-2962;96-900-2963;96-900-2964;96-900-2965;96-900-2966;96-900-2967;96-900-2968;96-900-2969;96-900-2970;96-900-2971;96-900-2972;96-900-2973;96-900-2974;96-900-2975;96-900-2976;96-900-2977;96-900-2978;96-900-2979;96-900-2980;96-900-2981;96-900-2982;96-900-2983;96-900-2984;96-900-2985;96-900-2986;96-900-2987;96-900-2988;96-900-3383;96-900-3384;96-900-3385;96-900-3386;96-900-3387;96-900-3388;96-900-3389;96-900-3390;96-900-3391;96-900-3392;96-900-3393;96-900-3394;96-900-3395;96-900-3396;96-900-3397;96-900-3398;96-900-3399;96-900-3400;96-900-3401;96-900-3402;96-900-3403;96-900-3404;96-900-3405;96-900-3406;96-900-3407;96-900-3408;96-900-3409;96-900-3410;96-900-3411;96-900-3412;96-900-3413;96-900-3414;96-900-3415;96-900-3416;96-900-3417;96-900-3418;96-900-3419;96-900-3420;96-900-3421;96-900-3422;96-900-3423;96-900-3424;96-900-

3425;96-900-3426;96-900-3427;96-900-3428;96-900-3429;96-900-3430;96-900-3431;96-900-3432;96-900-3433;96-900-3434;96-900-3435;96-900-3436;96-900-3437;96-900-3438;96-900-5435;96-900-6448;96-900-6564;96-901-0425;96-901-0426;96-901-0427;96-901-0428;96-901-0429;96-901-0430;96-901-0431;96-154-4616;96-154-4617;96-900-0167;96-900-0168;96-900-0268;96-900-0315;96-900-0316;96-900-0317;96-900-0318;96-900-0319;96-900-0320;96-900-0321;96-900-0322;96-900-0323;96-900-0324;96-900-0325;96-900-0326;96-900-0327;96-900-0535;96-900-0536;96-900-0537;96-900-0538;96-900-0539;96-900-0540;96-900-0541;96-900-0542;96-900-0788;96-900-1667;96-900-1668;96-900-1669;96-900-1670;96-900-1671;96-900-4323;96-900-4324;96-900-4325;96-900-4326;96-900-4327;96-900-4328;96-900-4329;96-900-4330;96-900-4331;96-900-4332;96-900-4333;96-900-7378;96-901-0755;96-901-0756;96-901-0757;96-901-0758;96-901-0759;96-901-0760;96-901-0761;96-901-0762;96-901-0763;96-901-0764;96-901-0765;96-901-0766;96-901-0776;96-901-0777;96-901-0778;96-901-0779;96-901-0780;96-901-0781;96-901-1462;96-901-1463;96-901-1464;96-901-1465;96-901-1466;96-901-1467;96-901-1468;96-901-3094;96-901-3095;96-901-3096;96-901-3097;96-901-3098;96-901-3099;96-901-3100;96-901-3101;96-901-3102;96-901-3640;96-901-3641;96-901-3642;96-901-4298;96-901-5075;96-901-5346;96-901-5659;96-901-6386;96-101-1033;96-101-1085;96-722-8111;96-900-0927;96-900-0928;96-900-0929;96-900-0930;96-900-0931;96-900-0932;96-900-0933;96-900-0934;96-900-0935;96-900-2317;96-900-2318;96-900-2319;96-900-2320;96-900-2321;96-900-2322;96-900-2323;96-900-2324;96-900-2325;96-900-2326;96-900-2327;96-900-2328;96-900-2329;96-900-2330;96-900-2331;96-900-2332;96-900-2333;96-900-2674;96-900-2675;96-900-4088;96-900-4156;96-900-4157;96-900-5813;96-900-5814;96-900-5815;96-900-5816;96-900-5817;96-900-5837;96-900-5838;96-900-5839;96-900-5840;96-900-5841;96-900-5842;96-900-5843;96-900-6185;96-900-6190;96-900-6195;96-900-6200;96-900-6243;96-900-6248;96-900-6253;96-900-6266;96-900-6921;96-900-6922;96-900-7645;96-900-7707;96-900-7708;96-900-9769;96-900-9770;96-901-0940;96-901-0941;96-901-0942;96-901-3530;96-901-3531;96-901-3532;96-901-3533;96-901-3534;96-901-3535;96-901-3536

Peak List

No.	2theta [°]	d [Å]	I/I0 (peak height)	Counts (peak area)	FWHM	Matched
1	11.18	7.9079	217.29	205.23	0.5236	
2	12.32	7.1786	1000.00	865.94	0.4800	A
3	19.54	4.5394	237.30	493.17	1.1520	D
4	22.20	4.0011	263.52	547.66	1.1520	C,D
5	24.58	3.6188	871.43	840.91	0.5349	A,D
6	27.94	3.1908	152.43	138.77	0.5047	D
7	29.62	3.0135	84.18	195.36	1.2864	D
8	30.10	2.9666	145.25	337.06	1.2864	B
9	30.64	2.9155	146.93	340.97	1.2864	D
10	32.48	2.7544	105.02	243.71	1.2864	D
11	33.30	2.6884	84.41	195.90	1.2864	D
12	36.04	2.4901	422.90	981.39	1.2864	A,D
13	36.74	2.4442	206.29	681.31	1.3323	C,D
14	39.52	2.2784	46.98	157.84	1.3552	D
15	42.26	2.1368	105.68	262.74	1.3782	A,D
16	43.24	2.0907	67.81	168.59	1.3782	B,C,D
17	51.10	1.7860	41.29	110.60	1.4849	A,D
18	52.60	1.7385	44.49	163.78	1.4849	A,C
19	54.02	1.6962	55.68	204.98	1.4849	A,C,D
20	57.14	1.6107	37.20	136.93	1.4849	B,D
21	60.32	1.5332	169.98	625.70	1.4849	A,D
22	61.78	1.5004	75.84	279.18	1.4849	A,D
23	62.88	1.4768	39.80	146.51	1.4849	B,C,D
24	64.02	1.4532	34.41	126.65	1.4849	A,D
25	66.06	1.4132	46.15	169.87	1.4849	A,B,C,D

Integrated Profile Areas

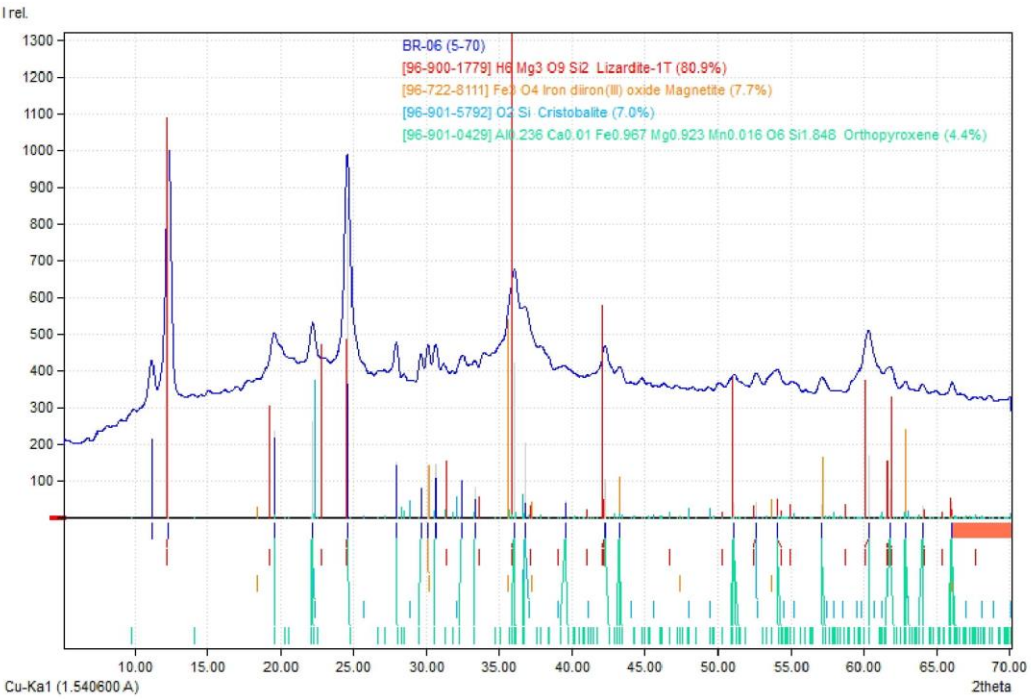
Based on calculated profile

Profile area	Counts	Amount
Overall diffraction profile	2409003	100.00%
Background radiation	2052580	85.20%
Diffraction peaks	356424	14.80%
Peak area belonging to selected phases	218338	9.06%
Peak area of phase A (Lizardite-1T)	*159102*	*6.60%*
Peak area of phase B (Iron diiron(III) oxide Magnetite)	*28329*	*1.18%*
Peak area of phase C (Cristobalite)	*19844*	*0.82%*
Peak area of phase D (Orthopyroxene)	*11063*	*0.46%*
Unidentified peak area	138086	5.73%

Peak Residuals

Peak data	Counts	Amount
Overall peak intensity	8621	100.00%
Peak intensity belonging to selected phases	7390	85.73%
Unidentified peak intensity	1230	14.27%

Diffraction Pattern Graphics



Sampel SAP-05

Match! Phase Analysis Report

Sample: SAP-LO-05 (5-70)

Sample Data

File name	SAP-LO-05.RAW
File path	C:/Users/reifa/Desktop/Data Thesis/Data XRD Reifan/SAP-LO-05
Data collected	May 24, 2021 14:03:24
Data range	4.930° - 69.930°
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
2theta correction	-0.07°
Radiation	X-rays
Wavelength	1.540600 Å

Matched Phases

Index	*Amount (%)*	*Name*	*Formula sum*
A	64.9	Lizardite	Al0.201 Fe0.339 H4 Mg2.544 O9 Si1.904
B	24.5	Goethite	Fe H O2
C	10.6	Cristobalite	O2 Si
	4.0	*Unidentified peak area*	

Amounts calculated by RIR (Reference Intensity Ratio) method

Elemental composition of sample (identified crystalline phases only)

Element	*Amount (weight %)*
O	56.06%
Si	21.18%
Mg	21.06%
Fe	15.40%
H	1.44%
LE (sum)	*57.50%*

Matching entry details

A: Lizardite (64.9 %)*

Formula sum	Al0.201 Fe0.339 H4 Mg2.544 O9 Si1.904
Entry number	96-901-6051
Figure-of-Merit (FoM)	0.704304*
Total number of peaks	114
Peaks in range	25
Peaks matched	12
Intensity scale factor	0.23*
Space group	P 3 1 m
Crystal system	trigonal (hexagonal axes)
Unit cell	a= 5.3263 Å c= 7.2885 Å
I/Ic	1.48
Calc. density	2.668 g/cm³
Reference	Laurora A., Brigatti M. F., Malferrari D., Galli E., "The crystal chemistry of lizardite-1T from northApennines ophiolites near Modena, ItalyNote: sample Santa Scolastica, polytype 1T", The Canadian Mineralogist **49**, 1045-1054 (2011)

B: Goethite (24.5 %)*

Formula sum	Fe H O2
Entry number	96-900-2159
Figure-of-Merit (FoM)	0.611378*
Total number of peaks	182
Peaks in range	32
Peaks matched	7
Intensity scale factor	0.15*
Space group	P n m a
Crystal system	orthorhombic
Unit cell	a= 9.9134 Å b= 3.0128 Å c= 4.5800 Å
I/Ic	2.57
Calc. density	4.314 g/cm³
Reference	Gualtieri A., Venturelli P., "In situ study of the goethite-hematite phase transformation by real timesynchrotron powder diffractionSample at T = 25 C", American Mineralogist **84**, 895-904 (1999)

C: Cristobalite (10.6 %)*

Formula sum	O2 Si
Entry number	96-900-8226

Figure-of-Merit (FoM)	0.677282*
Total number of peaks	138
Peaks in range	27
Peaks matched	9
Intensity scale factor	0.12*
Space group	P 41 21 2
Crystal system	tetragonal
Unit cell	a= 4.9820 Å c= 6.9630 Å
I/Ic	4.84
Calc. density	2.309 g/cm³
Reference	Peacor D. R., "High-temperature single-crystal study of the cristobalite inversionNote: Cell has been correctedSample: T = 65 CLocality: Ellora Caves, Hyderabad State, India", Zeitschrift fur Kristallographie **138**, 274-298 (1973)

(*)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'.

Candidates

Name	***Formula***	***Entry No.***	***FoM***
Zr6 B I12	B I12 Zr6	96-411-9076	0.7027
Lizardite-1T	H4 Mg3 O9 Si2	96-900-4511	0.6985
Lizardite-1T	Mg3 O9 Si2	96-900-4510	0.6877
Co Pt F6	Co F6 Pt	96-153-6614	0.6851
Gahnite	Al1.9 Fe0.075 Mg0.235 O4 Zn0.79	96-900-8097	0.6746
	Al2 Cu O4	96-900-5722	0.6730
CoAl2O4	Al2 Co O4	96-901-3650	0.6730
Th3 Ge2	Ge2 Th3	96-153-9179	0.6717
Gahnite	Al2 Fe0.2 O4 Zn0.8	96-900-6309	0.6699
Gahnite	Al2 Fe0.2 O4 Zn0.8	96-900-6313	0.6698
	Al2 Co0.75 O4 Zn0.25	96-901-4817	0.6697
	Al2 Co0.76 Mg0.25 O4	96-901-4512	0.6669
	Al2 Cu O4	96-900-5723	0.6666
Birnessite	H4.424 Mn O4.212	96-901-3653	0.6665
	C14 H12 N2 O4	96-210-0894	0.6642
B (O Te F5)3	B F15 O3 Te3	96-210-5416	0.6618
Ponomarevite	Cl10 Cu4 K4 O	96-901-6630	0.6607
Hercynite	Al1.82 Fe0.72 Mg0.29 O4	96-900-7359	0.6603
	Al2 Co O4	96-901-6166	0.6600
Gahnite	Al2 O4 Zn	96-900-6270	0.6575
Hercynite	Al1.84 Fe0.74 Mg0.29 O4	96-900-7358	0.6566
Lizardite-2H1	Mg3 O9 Si2	96-900-4513	0.6558
	Al2 Co O4	96-901-4827	0.6553
Potassium	K	96-901-1990	0.6532
Hercynite	Al1.81 Fe0.73 Mg0.29 O4	96-900-7360	0.6530
Silicon carbide (Moissanite 3C)	Si C	96-101-0996	0.6518
	C Si	96-900-8857	0.6518
Spinel	Al2 Co O4	96-900-5213	0.6506
	C6 H19 Cl2 Cu3 N9 O7	96-710-5832	0.6505
Lizardite-1T	H4 Mg3 O9 Si2	96-900-4509	0.6505
Lizardite	Al0.201 Fe0.339 H4 Mg2.544 O9 Si1.904	96-901-6051	0.6494
Spinel	Al2 Co O4	96-900-5205	0.6487
Spinel	Al2 Co O4	96-900-5218	0.6480
Spinel	Al2 Co O4	96-900-5220	0.6478
Spinel	Al2 Co O4	96-900-5209	0.6477
Spinel	Al2 Co O4	96-900-5204	0.6475
Spinel	Al2 Co O4	96-900-5215	0.6475
Spinel	Al2 Co O4	96-900-5216	0.6475
Spinel	Al2 Co O4	96-900-5208	0.6473
Ca (B2 S4)	B2 Ca S4	96-151-0885	0.6471
Tl2 Fe3 S4	Fe3 S4 Tl2	96-153-6856	0.6471
Spinel	Al2 Co O4	96-900-5211	0.6469
Spinel	Al2 Co O4	96-900-5206	0.6467
Spinel	Al2 Co O4	96-900-5207	0.6467
Spinel	Al2 Co O4	96-900-5219	0.6466
Spinel	Al2 Co O4	96-900-5217	0.6465
Spinel	Al2 Co O4	96-900-5210	0.6463
Lizardite-2H1	H4 Mg3 O9 Si2	96-900-4514	0.6462
Spinel	Al2 Co O4	96-900-5214	0.6462
Spinel	Al2 Co O4	96-900-5212	0.6455
La2 Cu O3.97	Cu La2 O3.97	96-154-0782	0.6442
Cs2 Ce (S O4)3	Ce Cs2 O12 S3	96-154-1179	0.6426

and 57 others...

Search-Match

Settings

Reference database used	COD-Inorg 2020.12.16
Automatic zeropoint adaptation	Yes
Downgrade entries with low scaling factors	Yes
Minimum figure-of-merit (FoM)	0.60

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	12.15	7.2786	965.07	1282.65	1.4115	A
2	19.39	4.5741	499.40	663.73	1.4115	A
3	21.37	4.1546	533.85	709.53	1.4115	B
4	22.05	4.0280	475.51	631.98	1.4115	C
5	24.37	3.6495	1000.00	1329.08	1.4115	A
6	31.17	2.8671	366.82	487.54	1.4115	A,C
7	33.21	2.6955	285.15	378.98	1.4115	B
8	35.91	2.4988	476.47	633.26	1.4115	A,B,C
9	36.77	2.4423	473.59	629.43	1.4115	A,B
10	41.93	2.1529	134.99	278.04	2.1874	A
11	53.71	1.7052	129.94	191.03	1.5613	B,C
12	60.17	1.5367	135.55	364.25	2.8537	A,C
13	61.73	1.5015	136.41	82.21	0.6400	A,B,C
14	65.09	1.4319	54.73	31.00	0.6016	A,C

Integrated Profile Areas

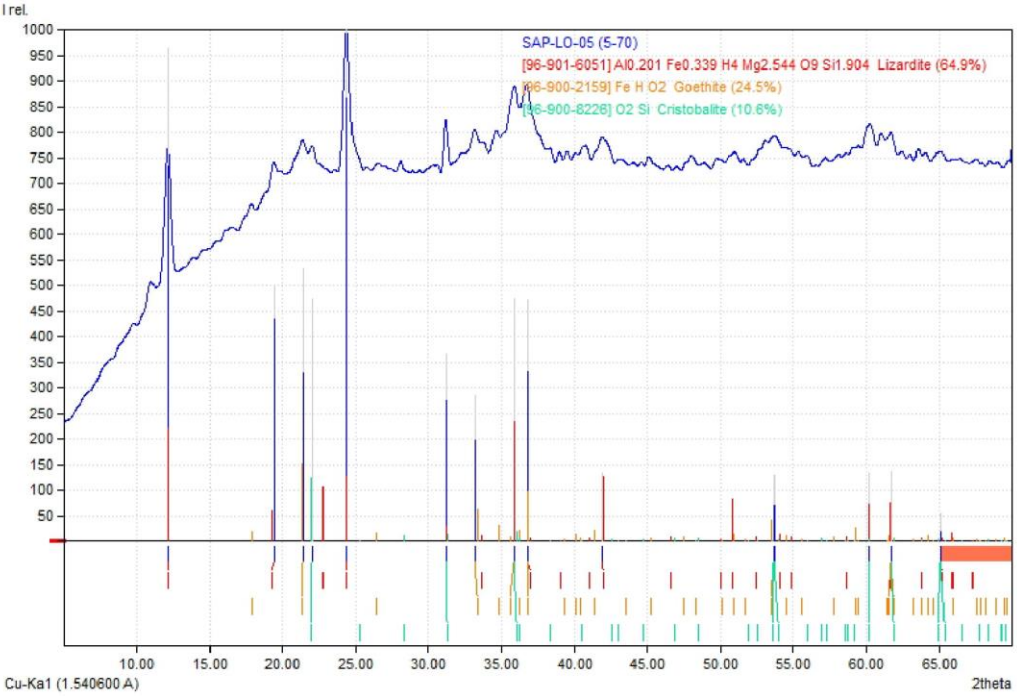
Based on calculated profile

Profile area	*Counts*	*Amount*
Overall diffraction profile	4379601	100.00%
Background radiation	3997973	91.29%
Diffraction peaks	381627	8.71%
Peak area belonging to selected phases	205116	4.68%
Peak area of phase A (Lizardite)	*119428*	*2.73%*
Peak area of phase B (Goethite)	*62569*	*1.43%*
Peak area of phase C (Cristobalite)	*23118*	*0.53%*
Unidentified peak area	176511	4.03%

Peak Residuals

Peak data	*Counts*	*Amount*
Overall peak intensity	7693	100.00%
Peak intensity belonging to selected phases	992	12.90%
Unidentified peak intensity	6700	87.10%

Diffraction Pattern Graphics



Sampel Sap-04

Match! Phase Analysis Report

Sample: SAP-HI-04 (5-70)

Sample Data

File name	SAP-HI-04.RAW
File path	C:/Users/reifa/Desktop/Data Thesis/Data XRD Reifan/SAP-HI-04
Data collected	May 24, 2021 14:03:24
Data range	4.910° - 69.910°
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
2theta correction	-0.09°
Radiation	X-rays
Wavelength	1.540600 Å

Matched Phases

Index	*Amount (%)*	*Name*	*Formula sum*
A	72.3	Lizardite	Al0.209 Fe0.105 H4 Mg2.787 O9 Si1.896
B	14.9	Goethite	Co0.03 Fe0.97 H O2
C	12.8	Cristobalite	O2 Si
	3.9	*Unidentified peak area*	

Amounts calculated by RIR (Reference Intensity Ratio) method

Elemental composition of sample (identified crystalline phases only)

Element	*Amount (weight %)*
O	67.59%
Fe	25.23%
Si	24.05%
Mg	23.46%
H	1.75%
LE (sum)	*69.35%*

Matching entry details

A: Lizardite (72.3 %)*

Formula sum	Al0.209 Fe0.105 H4 Mg2.787 O9 Si1.896
Entry number	96-901-5581
Figure-of-Merit (FoM)	0.757829*
Total number of peaks	114
Peaks in range	23
Peaks matched	11
Intensity scale factor	0.76*
Space group	P 3 1 m
Crystal system	trigonal (hexagonal axes)
Unit cell	a= 5.3234 Å c= 7.2721 Å
I/Ic	1.34
Calc. density	2.610 g/cm³
Reference	Laurora A., Brigatti M. F., Malferrari D., Galli E., Rossi A., "The crystal chemistry of lizardite-1T from northernApennines ophiolites near Modena, ItalyNote: Pompeano 3, polytype 1T", The Canadian Mineralogist **49**, 1045-1054 (2011)

B: Goethite (14.9 %)*

Formula sum	Co0.03 Fe0.97 H O2
Entry number	96-901-0408
Figure-of-Merit (FoM)	0.676702*
Total number of peaks	187
Peaks in range	28
Peaks matched	12
Intensity scale factor	0.36*
Space group	P b n m
Crystal system	orthorhombic
Unit cell	a= 4.6070 Å b= 9.9472 Å c= 3.0210 Å
I/Ic	3.11
Calc. density	4.267 g/cm³
Reference	Alvarez M., Sileo E. E., Rueda E. H., "Structure and reactivity of synthetic Co-substituted goethitesLocality: syntheticSample: G3, 3 mol% Co", American Mineralogist **93**, 584-590 (2008)

C: Cristobalite (12.8 %)*

Formula sum	O2 Si
Entry number	96-900-1579

Figure-of-Merit (FoM)	0.671483*
Total number of peaks	136
Peaks in range	24
Peaks matched	7
Intensity scale factor	0.48*
Space group	P 41 21 2
Crystal system	tetragonal
Unit cell	a= 4.9717 Å c= 6.9223 Å
I/Ic	4.83
Calc. density	2.332 g/cm³
Reference	Downs R. T., Palmer D. C., "The pressure behavior of alpha cristobaliteP = room pressure", American Mineralogist **79**, 9-14 (1994)

(*)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'.

Candidates

Name	*Formula*	*Entry No.*	*FoM*
	Cu Se	96-210-6769	0.6400
Zr3 V3 B0.372 O0.558 D5.944	B0.372 D5.944 O0.558 V3 Zr	96-152-7022	0.6272
	Pt Tl2	96-152-4517	0.6249
Ca2.4 Th0.6 Zr2 Fe2.9 O12	Ca2.4 Fe2.9 O12 Th0.6 Zr2	96-153-9418	0.6246
Phenakite	Be2 O4 Si	96-900-5791	0.6216
Phenakite	Be2 O4 Si	96-900-5858	0.6188
	Ni O13 Te6	96-701-2736	0.6034
	Al1.34 Ca Mg0.66	96-431-3242	0.6031
	B Ca H O5 Si	96-434-9852	0.6029

Search-Match

Settings	
Reference database used	COD-Inorg 2020.12.16
Automatic zeropoint adaptation	Yes
Downgrade entries with low scaling factors	Yes
Minimum figure-of-merit (FoM)	0.60
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	12.13	7.2906	856.39	650.75	0.5935	A
2	19.27	4.6023	186.64	587.99	1.2207	A
3	21.17	4.1934	183.75	876.36	1.8479	B
4	21.93	4.0497	192.02	915.78	1.8479	C
5	24.37	3.6495	422.41	2014.54	1.8479	A
6	26.57	3.3521	98.44	469.49	1.8479	B
7	28.45	3.1347	59.27	282.65	1.8479	C
8	31.27	2.8582	64.54	307.78	1.8479	A,C
9	33.25	2.6924	91.40	435.90	1.8479	B
10	34.67	2.5853	100.73	480.42	1.8479	B
11	35.89	2.5001	222.55	1061.36	1.8479	A,B,C
12	36.75	2.4436	159.66	761.43	1.8479	B
13	42.11	2.1441	68.00	324.28	1.8479	A
14	50.87	1.7935	32.67	155.80	1.8479	A,B
15	53.73	1.7046	52.56	250.68	1.8479	C
16	59.09	1.5621	33.05	157.64	1.8479	B,C
17	60.09	1.5385	84.97	405.24	1.8479	A,C
18	61.27	1.5117	65.59	312.80	1.8479	B
19	61.67	1.5028	60.67	289.32	1.8479	A,B

Integrated Profile Areas

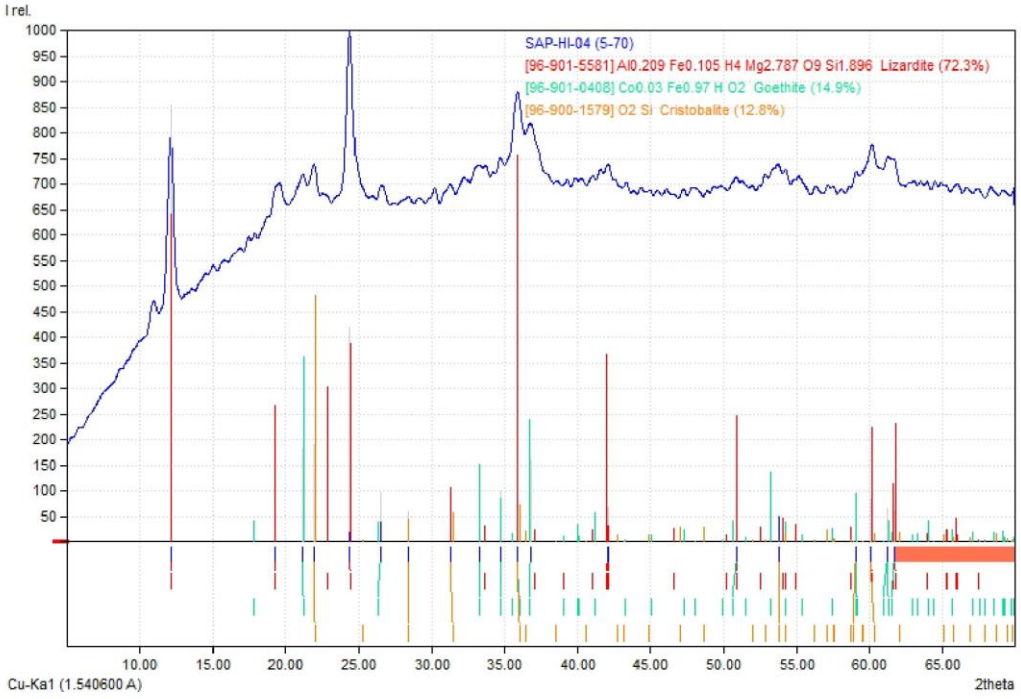
Based on calculated profile

Profile area	***Counts***	***Amount***
Overall diffraction profile	4181569	100.00%
Background radiation	3784495	90.50%
Diffraction peaks	397074	9.50%
Peak area belonging to selected phases	234801	5.62%
Peak area of phase A (Lizardite)	*142655*	*3.41%*
Peak area of phase B (Goethite)	*59342*	*1.42%*
Peak area of phase C (Cristobalite)	*32803*	*0.78%*
Unidentified peak area	162273	3.88%

Peak Residuals

Peak data	*Counts*	*Amount*
Overall peak intensity	10740	100.00%
Peak intensity belonging to selected phases	10074	93.79%
Unidentified peak intensity	667	6.21%

Diffraction Pattern Graphics



Sampel Trans-03

Match! Phase Analysis Report

Sample: TRANS-03 (5-70)

Sample Data

File name	TRANS-03.RAW
File path	C:/Users/reifa/Desktop/Data Thesis/Data XRD Reifan/TRANS-03
Data collected	May 24, 2021 14:03:24
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

Matched Phases

Index	*Amount (%)*	*Name*	*Formula sum*
A	100.0	Goethite	Fe H O2
	4.6	*Unidentified peak area*	

Amounts calculated by RIR (Reference Intensity Ratio) method

Elemental composition of sample (identified crystalline phases only)

Element	*Amount (weight %)*
Fe	62.85%
O	36.01%
H	1.13%
LE (sum)	*37.15%*

Matching entry details

A: Goethite (100.0 %)*

Formula sum	Fe H O2
Entry number	96-900-2160
Figure-of-Merit (FoM)	0.688704*
Total number of peaks	183
Peaks in range	183
Peaks matched	8
Intensity scale factor	0.71*
Space group	P n m a
Crystal system	orthorhombic
Unit cell	a= 9.9189 Å b= 3.0148 Å c= 4.5835 Å
I/Ic	2.38
Calc. density	4.306 g/cm³
Reference	Gualtieri A., Venturelli P., "In situ study of the goethite-hematite phase transformation by real timesynchrotron powder diffractionSample at T = 156 C", American Mineralogist **84**, 895-904 (1999)

(*)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'.

Candidates

Name	*Formula*	*Entry No.*	*FoM*
K (C N)	C K N	96-153-5717	0.7558
Iron(III) oxide hydroxide (Goethite)	Fe H O2	96-100-8767	0.7069
Goethite	Co0.03 Fe0.97 H O2	96-901-0408	0.7052
Goethite	Fe O2	96-901-5697	0.7033
(Tl0.5 Na0.5) (Ti O3)	Na0.5 O3 Ti Tl0.5	96-152-1915	0.6999
Iron(III) oxide hydroxide (Goethite)	Fe H O2	96-100-8768	0.6990
(Fe0.99 Cd0.01) O (O H)	Cd0.01 Fe0.99 H O2	96-153-2551	0.6990
Goethite	Fe H O2	96-901-0407	0.6974
Goethite	Fe H O2	96-900-2159	0.6953
Goethite	Fe O2	96-901-6179	0.6948
Goethite	Fe H O2	96-900-2160	0.6887
Iron(III) oxide hydroxide (Goethite)	Fe H O2	96-100-8769	0.6885
beta-triterbium heptastannide	Sn6.97 Tb3	96-210-5688	0.6881
Goethite	Fe O2	96-901-6407	0.6842
Goethite	Co0.1 Fe0.9 H O2	96-901-0411	0.6827
Goethite	Fe H O2	96-900-3079	0.6826
Goethite	Co0.05 Fe0.95 H O2	96-901-0409	0.6803
Goethite	Co0.07 Fe0.93 H O2	96-901-0410	0.6802
Goethite	Fe H O2	96-900-3077	0.6753
Cr Sr2 Y Cu2 O8	Cr Cu2 O8 Sr2 Y	96-153-3074	0.6743
Goethite	Fe H O2	96-221-1653	0.6716

Montroseite	Fe0.125 H O2 V0.875	96-900-0060	0.6693
Montroseite	H O2 V	96-900-0071	0.6669
Sr2 Y (Fe Cu2) O7.68	Cu2 Fe O7.68 Sr2 Y	96-153-1765	0.6641
Sr2 Y (Cu0.1 Fe0.9) (Cu0.95 Fe0.05)2 O7.32	Cu2 Fe O7.32 Sr2 Y	96-153-1774	0.6632
Sr2 Y (Fe Cu2) O7.60	Cu2 Fe O7.6 Sr2 Y	96-153-1767	0.6615
Si O2	O2 Si	96-153-9935	0.6527
(Sr0.685 Dy0.315) (Co O2.615)	Co Dy0.315 O2.615 Sr0.685	96-152-9131	0.6501
Y0.33 Sr0.67 Co O2.79	Co O2.79 Sr0.67 Y0.33	96-153-6628	0.6468
Nd Ni O3	Nd Ni	96-153-5733	0.6452
Ho0.33 Sr0.67 Co O2.76	Co Ho0.33 O2.76 Sr0.67	96-153-6635	0.6393
Gd0.33 Sr0.67 (Co O2.82)	Co Gd0.33 O2.82 Sr0.67	96-153-6011	0.6364
	Co O3 Sr0.7 Y0.3	96-400-0320	0.6344
	Cr F13 Pb5	96-350-0059	0.6325
Lithium hydrogen titanium tellurium (.3/1.7/1/1/6)	H1.68 Li0.32 O6 Te Ti	96-100-0337	0.6321
	O3 Te0.5 Ti0.5	96-901-6374	0.6319
Cerium palladium antimonide (3/6/5)	Ce3 Pd6 Sb5	96-100-5018	0.6312
Mg (P4 O11)	Mg O11 P4	96-810-4400	0.6302
cesium arsenate	As3 Cs O8	96-210-2800	0.6293
rubidium nickel silicon oxide	Ni O12 Rb2 Si5	96-224-1525	0.6270
Co Sr2 (Y0.6 Ca0.4) Cu2 O7.152	Ca0.4 Co Cu2 O7.152 Sr2 Y0.6	96-152-8482	0.6236
	Ag I3 O8	96-400-1945	0.6178
Zn P4 O11	O11 P4 Zn	96-810-4383	0.6161
Si O2	O2 Si	96-153-6390	0.6129
Co (P4 O11)	Co O11 P4	96-810-4075	0.6124
Na Cs2 Al (P O4)2	Al Cs2 Na O8 P2	96-400-2337	0.6078
Cu2 (O H)3 I	Cu2 H3 I O3	96-153-8451	0.6032
	Ca F5 Ti	96-154-5630	0.6020
Al7.85 Mn4.12 Ho	Al7.85 Ho Mn4.12	96-152-2556	0.6015
Al8 Mn4 Dy	Al8 Dy Mn4	96-152-2555	0.6013

Search-Match

Settings

Reference database used	COD-Inorg 2020.12.16
Automatic zeropoint adaptation	Yes
Downgrade entries with low scaling factors	Yes
Minimum figure-of-merit (FoM)	0.60
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	21.40	4.1488	581.33	1399.26	7.5000	A
2	26.72	3.3336	1000.00	2407.02	7.5000	A
3	33.36	2.6837	567.47	1365.91	7.5000	A
4	36.76	2.4429	420.89	1013.09	7.5000	A
5	40.60	2.2203	77.61	43.39	1.7418	A
6	53.74	1.7043	54.82	131.95	7.5000	A
7	59.38	1.5552	73.91	177.91	7.5000	A

Integrated Profile Areas

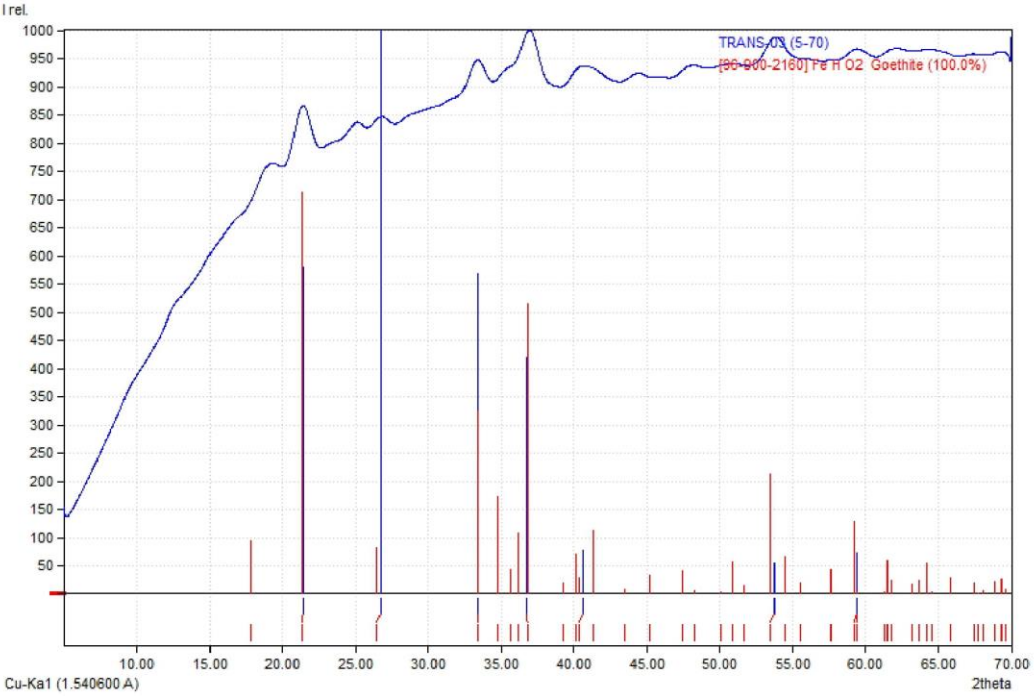
Based on calculated profile

Profile area	*Counts*	*Amount*
Overall diffraction profile	6411779	100.00%
Background radiation	5947753	92.76%
Diffraction peaks	464026	7.24%
Peak area belonging to selected phases	169498	2.64%
Peak area of phase A (Goethite)	*169498*	*2.64%*
Unidentified peak area	294528	4.59%

Peak Residuals

Peak data	*Counts*	*Amount*
Overall peak intensity	6539	100.00%
Peak intensity belonging to selected phases	0	0.00%
Unidentified peak intensity	6539	100.00%

Diffraction Pattern Graphics



Sampel Lim-02

Match! Phase Analysis Report

Sample: LIM-HI-02 (5-70)

Sample Data

File name	LIM-HI-02.RAW
File path	C:/Users/reifa/Desktop/Data Thesis/Data XRD Reifan/LIM-HI-02
Data collected	May 24, 2021 14:03:24
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

Matched Phases

Index	*Amount (%)*	*Name*	*Formula sum*
A	100.0	Goethite	Fe O2
	3.1	*Unidentified peak area*	

Amounts calculated by RIR (Reference Intensity Ratio) method

Elemental composition of sample (identified crystalline phases only)

Element	*Amount (weight %)*
Fe	63.57%
O	36.43%
LE (sum)	*36.43%*

Matching entry details

A: Goethite (100.0 %)*

Formula sum	Fe O2
Entry number	96-901-5697
Figure-of-Merit (FoM)	0.615133*
Total number of peaks	187
Peaks in range	187
Peaks matched	4
Intensity scale factor	0.90*
Space group	P b n m
Crystal system	orthorhombic
Unit cell	a= 4.6188 Å b= 9.9528 Å c= 3.0236 Å
I/Ic	3.17
Calc. density	4.198 g/cm³
Reference	Hazemann J.-L., Bérar J. F., Manceau A., "Rietveld studies of the aluminium-iron substitution in synthetic goethite", Materials Science Forum **79-82**, 821-826 (1991)

(*)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 2020.12.16
Automatic zeropoint adaptation	Yes
Downgrade entries with low scaling factors	Yes
Minimum figure-of-merit (FoM)	0.60
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	18.38	4.8232	882.22	1114.26	1.4959	
2	21.42	4.1450	1000.00	1263.02	1.4959	A
3	33.06	2.7074	414.94	1245.09	3.5540	A
4	36.88	2.4353	576.12	731.75	1.5044	A
5	53.24	1.7191	71.92	179.59	0.7600	A
6	53.24	1.7191	186.84	429.47	2.7225	

Integrated Profile Areas

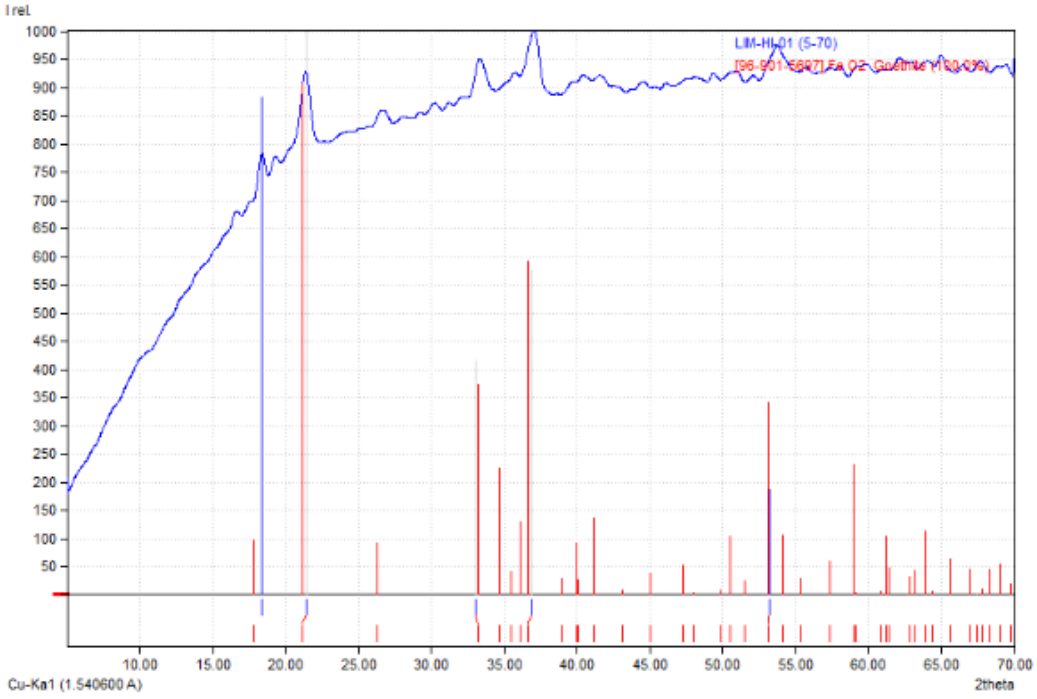
Based on calculated profile

Profile area	*Counts*	*Amount*
Overall diffraction profile	6643055	100.00%
Background radiation	6199595	93.32%
Diffraction peaks	443459	6.68%
Peak area belonging to selected phases	236611	3.56%
Peak area of phase A (Goethite)	*236611*	*3.56%*
Unidentified peak area	206848	3.11%

Peak Residuals

Peak data	*Counts*	*Amount*
Overall peak intensity	4963	100.00%
Peak intensity belonging to selected phases	3419	68.90%
Unidentified peak intensity	1544	31.10%

Diffraction Pattern Graphics



Sampel Lim-01

Match! Phase Analysis Report

Sample: LIM-LO-01 (5-70)

Sample Data

File name	LIM-LO-01.RAW
File path	C:/Users/reifa/Desktop/Data Thesis/Data XRD Reifan/LIM-LO-01
Data collected	May 24, 2021 14:03:24
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

Matched Phases

Index	*Amount (%)*	*Name*	*Formula sum*
A	74.2	Goethite	Co0.03 Fe0.97 H O2
B	25.8	Magnetite	Fe3 O4
	3.8	*Unidentified peak area*	

Amounts calculated by RIR (Reference Intensity Ratio) method

Elemental composition of sample (identified crystalline phases only)

Element	*Amount (weight %)*
Fe	144.20%
O	79.05%
H	2.27%
LE (sum)	*81.32%*

Matching entry details

A: Goethite (74.2 %)*

Formula sum	Co0.03 Fe0.97 H O2
Entry number	96-901-0408
Figure-of-Merit (FoM)	0.717228*
Total number of peaks	187
Peaks in range	187
Peaks matched	15
Intensity scale factor	1.00*
Space group	P b n m
Crystal system	orthorhombic
Unit cell	a= 4.6070 Å b= 9.9472 Å c= 3.0210 Å
I/Ic	3.11
Calc. density	4.267 g/cm³
Reference	Alvarez M., Sileo E. E., Rueda E. H., "Structure and reactivity of synthetic Co-substituted goethitesLocality: syntheticSample: G3, 3 mol% Co", American Mineralogist **93**, 584-590 (2008)

B: Magnetite (25.8 %)*

Formula sum	Fe3 O4
Entry number	96-900-5841
Figure-of-Merit (FoM)	0.794762*
Total number of peaks	36
Peaks in range	36
Peaks matched	6
Intensity scale factor	0.65*
Space group	F d -3 m
Crystal system	cubic
Unit cell	a= 8.3557 Å
I/Ic	5.76
Calc. density	5.272 g/cm³
Reference	Nakagiri N., Manghnani M. H., Ming L. C., Kimura S., "Crystal structure of magnetite under pressureSample: P = 2.76 GPa", Physics and Chemistry of Minerals **13**, 238-244 (1986)

(*)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'.

Candidates

Name	*Formula*	*Entry No.*	*FoM*
(Y0.6 Cu0.4) (Y0.2 Mo0.8) Ba2 O6	Ba2 Cu0.4 Mo0.8 O6 Y0.8	96-152-6204	0.7175
Ba8 Fe2 Sc3.336 U2.668 O24	Ba8 Fe2 O24 Sc3.336 U2.668	96-154-1331	0.7174
Ba8.028 Fe4.264 Dy1.04 U2.668 O24	Ba8.028 Dy1.04 Fe4.264 O24 U2.668	96-154-1367	0.7172

Ba2 Yb Sb O6	Ba2 O6 Sb Yb	96-153-5934	0.7165
Dibarium iron(III) uranium(V) oxide	Ba2 Fe O6 U	96-100-1095	0.7146
Ba7.996 Fe4.264 Y1.068 U2.668 O24	Ba7.996 Fe4.264 O24 U2.668 Y1.068	96-154-1337	0.7140
Dibarium calcium hexaoxidotellurate	Ba2 Ca O6 Te	96-231-1580	0.7127
Ba2 Ca Os O6	Ba2 Ca O6 Os	96-152-9020	0.7121
Ba8.04 Fe3.72 Lu1.56 U2.68 O24	Ba8.04 Fe3.72 Lu1.56 O24 U2.68	96-154-1347	0.7118
Ba2 Ho Re O6	Ba2 Ho O6 Re	96-153-4226	0.7063
	Ba2 Ca Ir O6	96-403-0607	0.7047
Ba2 Ca Re O6	Ba2 Ca O6 Re	96-152-9018	0.7041
Ba8 Fe1.332 Sc4 U2.668 O24	Ba8 Fe1.332 O24 Sc4 U2.668	96-154-1332	0.6971
Cuprospinel	Cu Fe2 O4	96-591-0029	0.6955
CoFe2O4	Co Fe2 O4	96-591-0064	0.6936
Ba2 Tb Ir O6	Ba2 Ir O6 Tb	96-152-9058	0.6920
Barium platinum holmium oxide (8/4/3/17.5)	Ba8 Ho3 O17.5 Pt4	96-200-2555	0.6903
Barium platinum(IV) platinum yttrium oxide (8/3/1/3/17.5)	Ba8 O17.5 Pt4 Y3	96-200-2435	0.6896
Ba8 Fe2.668 In2.664 U2.668 O24	Ba8 Fe2.668 In2.664 O24 U2.668	96-154-1374	0.6892
Potassium	K	96-901-1982	0.6871
Ba (In0.65 Ga0.35) O2.5	Ba Ga0.35 In0.65 O2.5	96-152-2067	0.6861
Iron diiron(III) oxide (Magnetite)	Fe3 O4	96-722-8111	0.6814
Zinc diiron(III) oxide	Fe2 O4 Zn	96-101-0131	0.6808
(Ba0.8 Ca0.2) (Zr O3)	Ba0.8 Ca0.2 O3 Zr	96-153-2764	0.6797
Franklinite	Fe2 O4 Zn	96-900-6897	0.6790
Zincochromite	Cr2 O4 Zn	96-900-3709	0.6775
NiFe2O4	Fe2 Ni O4	96-591-0065	0.6771
(Zn0.759 Mn0.241) (Mn1.35 Ni0.65) O4	Mn1.591 Ni0.65 O4 Zn0.759	96-152-6210	0.6769
Zincochromite	Cr2 O4 Zn	96-900-3710	0.6763
	Fe Ga2 O4	96-154-1528	0.6757
	Cu Mn2 O4	96-153-3675	0.6751
Ga2 Cu.8 Cd.2 O4	Cd0.2 Cu0.8 Ga2 O4	96-153-5211	0.6750
Ba2 Yb Ta O6	Ba2 O6 Ta Yb	96-152-2006	0.6746
	Fe3 O4	96-230-0617	0.6745
Zincochromite	Cr2 O4 Zn	96-900-3708	0.6744
Ni Mn.5 Cr1.5 O4	Cr1.5 Mn0.5 Ni O4	96-152-6358	0.6743
Fe2MnO4	Fe2 Mn O4	96-230-0619	0.6743
Ba2 Dy Re O6	Ba2 Dy O6 Re	96-153-4225	0.6738
Ba8 Fe3.72 Tm1.6 U2.68 O24	Ba8 Fe3.72 O24 Tm1.6 U2.68	96-154-1361	0.6737
Magnetite	Fe3 O4	96-900-5841	0.6737
(Fe0.92 Mg0.08) (Fe1.08 Ni0.2 Mg0.72) O4	Fe2 Mg0.8 Ni0.2 O4	96-152-7033	0.6735
(Co0.68 Fe0.18 Cr0.14) (Co0.32 Fe0.62 Cr0.86 Ga0.2) O4	Co Cr Fe0.8 Ga0.2 O4	96-153-3576	0.6735
Li.5 Fe2 V.5 O4	Fe2 Li0.5 O4 V0.5	96-154-1496	0.6727
Magnetite	Fe3 O4	96-900-2320	0.6724
Franklinite	Fe2 O4 Zn	96-900-6898	0.6722
Magnesium diiron(III) oxide (Magnesioferrite)	Fe2 Mg O4	96-101-1242	0.6719
Zincochromite	Cr2 O4 Zn	96-900-3711	0.6718
Magnetite	Fe3 O4	96-900-5840	0.6717
(Fe0.8 Zn0.2) (Fe1.2 Ni0.2 Mg0.6) O4	Fe2 Mg0.6 Ni0.2 O4 Zn0.2	96-152-7034	0.6715
Ba (Zr O3)	Ba O3 Zr	96-153-8370	0.6715
Eu2 Ba Ta O5.5	Ba Eu2 O5.5 Ta	96-434-3690	0.6715
(Fe0.95 Mg0.05) ((Ni0.25 Cu0.7 Fe0.75 Cr0.3) O4)	Cr0.3 Cu0.7 Fe1.7 Mg0.05 Ni0.25 O4	96-153-2572	0.6714

and 233 others...

Search-Match

Settings

Reference database used	COD-Inorg 2020.12.16
Automatic zeropoint adaptation	Yes
Downgrade entries with low scaling factors	Yes
Minimum figure-of-merit (FoM)	0.60
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	21.26	4.1758	1000.00	1876.58	2.0805	A
2	30.26	2.9512	544.59	550.15	1.1200	B
3	33.26	2.6916	492.78	998.84	2.2472	A
4	35.62	2.5185	717.64	724.97	1.1200	A,B
5	36.80	2.4404	760.78	768.56	1.1200	A
6	39.92	2.2565	344.91	448.20	1.4407	A
7	40.98	2.2006	226.57	327.19	1.6010	A
8	43.24	2.0907	28.09	114.59	1.1200	A,B
9	48.04	1.8924	159.15	491.01	3.4204	A
10	53.44	1.7132	259.01	411.51	1.7614	A,B
11	55.24	1.6615	195.25	310.20	1.7614	A
12	57.26	1.6076	272.90	275.69	1.1200	A,B
13	59.00	1.5643	50.36	205.48	1.1200	A
14	62.92	1.4759	106.70	363.18	3.7737	A,B

Integrated Profile Areas

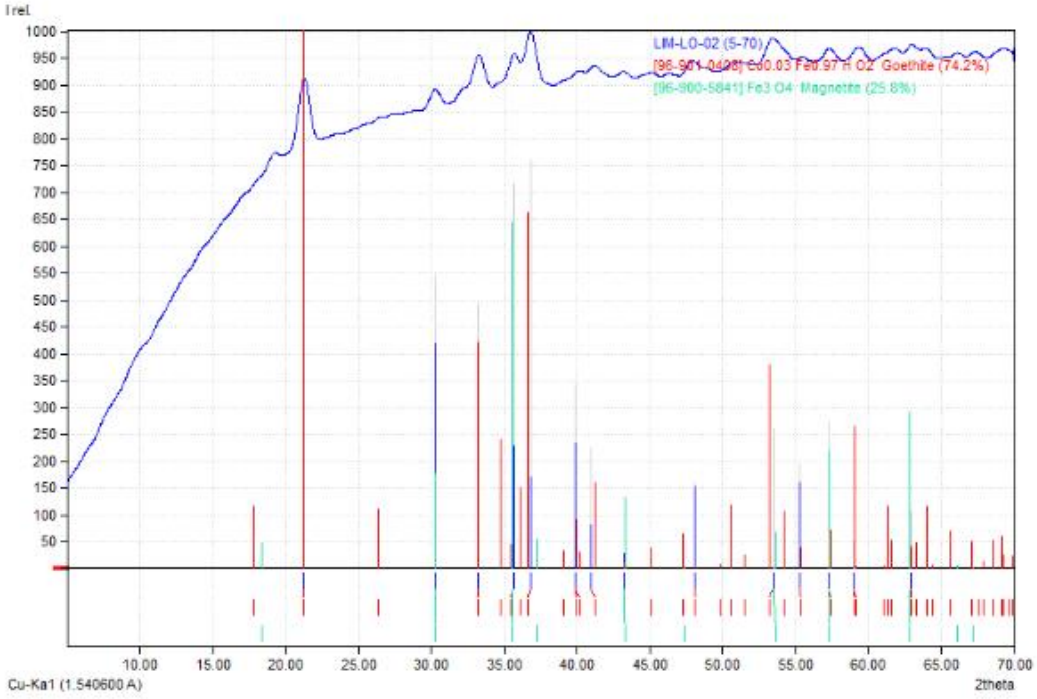
Based on calculated profile

Profile area	*Counts*	*Amount*
Overall diffraction profile	7452579	100.00%
Background radiation	6904507	92.65%
Diffraction peaks	548073	7.35%
Peak area belonging to selected phases	267756	3.59%
Peak area of phase A (Goethite)	*214495*	*2.88%*
Peak area of phase B (Magnetite)	*53260*	*0.71%*
Unidentified peak area	280317	3.76%

Peak Residuals

Peak data	*Counts*	*Amount*
Overall peak intensity	7866	100.00%
Peak intensity belonging to selected phases	3678	46.76%
Unidentified peak intensity	4188	53.24%

Diffraction Pattern Graphics



Lampiran C
Hasil Pengolahan Data XRF

Certificate No. 00959/AO AO
Date: April 30, 2021

SUCOFINDO

Issuing Office:
Jl. Pattimura No.58,Puuwatu, Kendari, Indonesia
Phone: 04013418753

REPORT OF ANALYSIS

PRINCIPAL : REIFAN FAHRISYAH
JL. MUHAJIRIN 1 NO. 23 RT. 003 RW. 003
MANGASA, TAMALATE
KOTA MAKASSAR SULAWESI SELATAN

TYPE OF SAMPLE : Nickel Ore
TESTED FOR : Chemical Analysis
DESCRIPTION OF SAMPLE : Form : Soil
Packing : Plastic Bag
DATE RECEIVED : 28/04/2021
DATE OF ANALYSED : 30/04/2021
SAMPLE MARK :
1. LIM 01
2. LIM 02
3. TRA 03
4. SAP 04
5. SAP 05
6. BR 06

ANALYSIS METHOD : Analysis by X – RAY Fluorescence (XRF)

Result:

Parameter	Unit	Results						Test Method
		1	2	3	4	5	6	
Fe	%	31.66	47.38	31.63	12.79	12.44	6.28	PO – MOM – 01 (XRF)
Fe_2O_3	%	45.27	67.75	45.22	18.29	17.79	8.98	PO – MOM – 01 (XRF)
Al_2O_3	%	16.12	4.46	9.64	4.99	5.09	2.94	PO – MOM – 01 (XRF)
CaO	%	0.07	0.08	0.08	0.10	0.25	2.59	PO – MOM – 01 (XRF)
MgO	%	5.21	1.05	6.97	24.55	24.21	35.15	PO – MOM – 01 (XRF)
Cr_2O_3	%	2.96	3.18	2.42	0.83	0.77	0.60	PO – MOM – 01 (XRF)
Na_2O	%	0.00	0.00	0.00	0.00	0.00	0.00	PO – MOM – 01 (XRF)
K_2O	%	0.00	0.00	0.00	0.00	0.00	0.00	PO – MOM – 01 (XRF)
SiO_2	%	15.10	5.54	19.94	36.70	37.60	39.06	PO – MOM – 01 (XRF)
TiO_2	%	0.37	0.14	0.25	0.10	0.12	0.03	PO – MOM – 01 (XRF)
Ni	%	1.41	1.62	2.13	2.56	2.45	0.36	PO – MOM – 01 (XRF)
Co	%	0.08	0.09	0.10	0.08	0.07	0.03	PO – MOM – 01 (XRF)
MnO	%	0.66	1.15	1.18	0.33	0.33	0.11	PO – MOM – 01 (XRF)

THE RESULT OF TESTING ANALYSIS ONLY REFERS TO THE SAMPLE SUBMITTED AS THE SAMPLE WAS NOT TAKEN BY PT SUCOFINDO

This Certificate/report is issued under our General Terms and Conditions, copy of which is available upon request or may be accessed at www.sucofindo.co.id

Dept. Of Inspection & Testing

for
Muhammad Heru

3802347

SCI-2007A

Lampiran D
Deskripsi Pengamatan Mikroskop Batuan Dasar

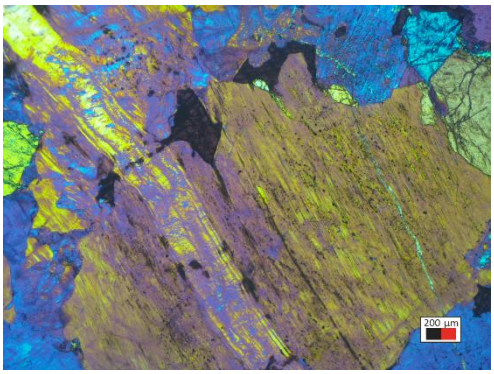
No lampiran / No conto : BR-06 Nama Batuan:

Tipe Batuan : Batuan Beku

Klasifikasi :

Foto

// – Nikol



X – Nikol

Mikroskopis:

Sayatan batuan beku ini abu-abu kehitaman pada nikol sejajar, berwarna biru hingga hijau pada nikol silang. Adapun mineral penyusun batuan yaitu Serpentin, Ortopiroksin, Magnetit dan Cristobalit.

Deskripsi Mineralogi

Komposisi Mineral	Jumlah (%)	Keterangan Optik mineral
Serpentin (4D)	**77**	Pada nikol sejajar memiliki warna abu-abu hingga kehijauan, relief rendah,
Orthopiroksin (4H)	**17**	Pada nikol sejajar abu-abu kehitaman dan pada nikol silang berwarna abu-abu kehitaman, bentuk subhedral – anhedral, relief tinggi, ukuran mineral 0,01-,01 μm.
Magnetit (5F)	**1**	Pada nikol sejajar berwarna abu abu gelap, relief tinggi, ukuran mineral 0,1 – 10 μm
Christobalite (2E)	**5**	Pada nikol sejajar abu-abu gelap, relief sedang, intensitas sedang, ukuran mineral 1-200 μm.