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Experimental study partial melting of the matabasites in the system H_2O–NaCl

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Experimental studies of interactions amphibolites with pure water (H_2O) and NaCl solutions of different concentrations (X_{NaCl} = 0.1 - 0.5) were conducted at temperature 900°C and at pressures of 5 kbar. A finely ground amphibolite (Amph) is used as a staring material. Major components of the amphibolite are plagioclase, An_{46} (from 25 to 30 mass %), and amphibole, pargasite, (≈ 70 mass %). The amphibole composition is: SiO_2 – 40.80, TiO_2 – 2.17, Al_2O_3 – 11.47, FeO – 17.22, MnO – 0.19, MgO – 9.57, CaO – 11.25, Na_2O – 2.62, K_2O – 1.46, Cl – 0.080, H_2O (loss on ignition) – 1.8; total: – 98.60 mass %. A sample of the initial material (usually from 35 to 40 mg) is lased in the ampoule and poured with the NaCl solution (a sample/solution ratio is 1/10). The ampoules were sealed and withstood at run's P-T conditions during 7 days followed by quenching of rate 100°C/min. The ampoules were gold, keeping transport of iron in/through ampoule walls. Oxygen fugacity f_{O2} was not controlled, we believe that f_{O2} is closed to that of the Ni–NiO buffer [*Helz, 1976*]. When ampoules were opened, compositions of mineral phases, melts and quenched glasses, revealed in amphibolites, were investigated by a local x-ray spectral microanalysis technique using the electron scanning microscope "CamScan MV 2300" supplying with the energy dispersive spectrometer containing the semiconducting Si(Li) detector and the "INCA Energy" software.

Experiments showed that amphibole (Hbl) the major mineral phase, was observed in all runs quite apart from the NaCl concentration in the initial fluid. Rare occurring clinopyroxenes are resulted from interactions of amphibolite and pure water and/or with diluted (from 1 to 5 mass % NaCl) water solutions. Increase of the NaCl concentration in the initial solution expands the field of stability for amphibole. Melt (Gl) resulting from the partial melting of amphibolite forms cement matrix between minerals. The average chemical composition of the melts is following: SiO_2 – 60–62 mass %, Al_2O_3 – 23–25 %, Na_2O – 8–11%, (CaO+MgO+FeO) < 10%. All melts have quartz-norm compositions. As X_{NaCl} in the fluid increases, the melts are enriched in Al_2O_3 and Na_2O and depleted in CaO and K_2O, but their compositions remain the quartz-norm ones. Nepheline-norm melts are only formed at X_{NaCl} > 0.5. Concentration of Cl in the melt increases from 0.4 to 1.5 mass % with increasing X_{NaCl} in the initial fluid from 0.1 to 0.47. The quenched phase (Fl) precipitating from the solution is easily detected and analyzed since it present as spheres with diameters from 20 to 80-150 μm. Chemical compositions of the Gl and Fl melts is practically identical, testifies that at the parameters of 5 кбар and 900°C we are near in area of critical curve glace-fluid.

The initial amphibole in amphibolite is pargasite [*Leake et al.,* 1997]. After experiments, the amphiboles became strong inhomogeneous: they are zoned crystals, in which magnesium concentration increase from the centre of grains to their edges, *i.e.*, $Fe^{2+} \rightarrow Mg^{2+}$. Zoning of amphiboles was observed in the experimental runs with pure H_2O as well as in those with NaCl solution. Amphiboles from runs with high concentrations of NaCl (X_{NaCl} > 0.5) are homogeneous, their compositions is not changed from the centre of grain to its edge. As it follows from the reaction $(Mg,Fe)_{Hbl} + H_2O \rightarrow (Mg)_{Hbl} + Fe(Sol)$, where Fe(Sol) denotes Fe complexes in the fluid as, increasing activity of water (a_{H2O}) in solution leads to the predominant leakage of Fe from mineral with respect to that of Mg. Another common type of isomorphic substitution in amphiboles is Ca + (Mg, Fe^{2+}) → Na + (Al, Fe^{3+}). A direct correlation between the NaCl fluid (XNaCl = 0.1–0.5 concentration) and concentration of Cl in the amphiboles (0.1–0.3 mass. %) is observed.

Key words: experiment, amphibolites, NaCl, fluid

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