METASOMATIC ALTERATION PRODUCTS OF TRIPHYLITE FROM THE PALERMO #2 PEGMATITE, NORTH GROTON, NEW HAMPSHIRE.

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An investigation of the mineralogy of Palermo #2 pegmatite in North Groton, New Hampshire has revealed a number of secondary phosphate species produced by the metasomatic alteration of primary triphylite. The Palermo #2 is a rare-element pegmatite of the beryl-phosphate subtype located in the Grafton pegmatite field of west-central New Hampshire. The primary phosphates triphylite, fluorapatite, hydroxylapatite and montebrasite occur chiefly in the core margin. Triphylite from Palermo #2 has an Fe/(Fe+Mn) ratio of 0.83 and an Fe/(Fe+Mg) ratio of 0.85. The high Fe/(Fe+Mn) value and moderate (from 3.3 to 4.0 %) MgO content in triphylite as well as a dearth of additional Li-bearing non-phosphate species suggest a moderately fractionated system consistent with that of a beryl-phosphate subtype. Late-stage, carbonate-bearing aqueous fluids have metasomatically altered these primary phosphates producing a diverse suite of nearly 40 species of secondary phosphate minerals and associated carbonates. A large percentage of the secondary phosphates occurring at Palermo #2 are a consequence of the alteration of triphylite. Two paragenetic sequences resulting from subsolidus metasomatism of triphylite by aqueous fluids are evident: an oxidizing sequence and a non-oxidizing sequence. Under oxidizing conditions and high temperatures (~500-300ºC) triphylite alters in accordance with the Mason-Quensel sequence (triphylite → ferrisicklerite – Li^+ → heterosite). Lower temperature (~300-<100ºC) metasomatic secondary phosphates forming under oxidizing conditions include: rockbridgeite, kryzhanovskite, jahnsite-(CaMnFe), jahnsite-(CaMnMn), strunzite, laueite, paravauxite, ushkovite, stewartite, whitmoreite, beraunite, mitridatite, strengite and phosphosiderite. In the presence of non-oxidizing conditions and high temperatures (~500-300ºC) triphylite may alter to wolfeite (triphylite – Li^+ + OH^- → wolfeite) or scorzalite (triphylite – Li^+ + Al^{3+} + OH^- → scorzalite). Lower temperature (~300-<100ºC) metasomatic secondary phosphates forming under non-oxidizing conditions include: childrenite-eosphorite, ludlamite, vivianite, messelite-fairfieldite and gormanite. The considerable number of secondary phosphates at Palermo #2 is not exclusively the result of the metasomatic alteration of triphylite. Other primary phosphates (fluorapatite, hydroxylapatite, montebrasite), silicates, carbonates, sulfides, arsenides and oxides locally present in the core margin are affected by and contribute additional ions to the alterative hydrothermal fluids. Consequently the concomitant alteration of both triphylite and the associated mineral species is responsible for the formation of the diverse suite of secondary phosphates.