SOLUBILITY OF ORE ACCESSORY MINERALS IN LI-F GRANITIC MELTS: APPLICATION OF EXPERIMENTAL RESULTS HIGHLY PERALUMINOUS COMPOSITIONS

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It is well known, that ore accessory minerals – tantalite-columbite and wolframite host the significant fractions of rare metals in evolved granite rocks. It is safe to assume that crystallization of these minerals at the early stages of magma differentiation facilitates the dispersion of ore elements and prevents their enrichment in the residual melts. An another scenario suppose the high solubility of ore minerals throughout the differentiation process (due to the specific melt composition and/or high temperature) which eventually leads to extreme accumulations of rare metals in the late residual melts.

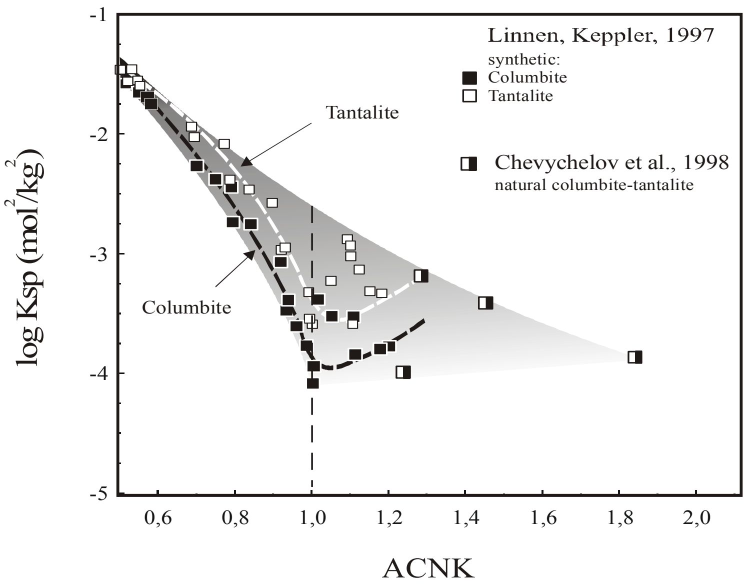

Fig.1. The dependence of the log solubility products (Ksp) of manganotantalite, manganocolumbite and natural columbite-tantalite on the composition of water–saturated granitic melts at 800^{0}C and 2 kbar. ACNK – molar Al/(Na+K+2Mn); Ksp= [FeO+MnO]*[Nb_2O_5+Ta_2O_5];

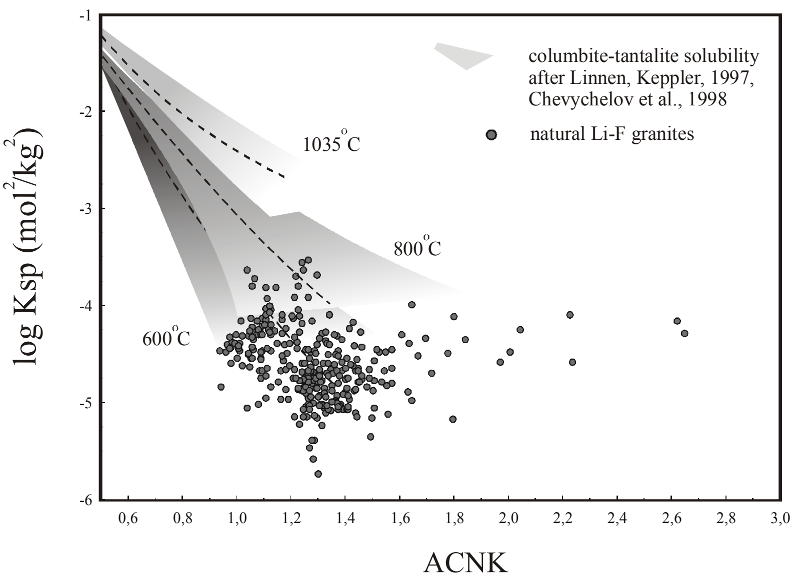

Fig.2. The dependence of the log solubility products of columbite-tantalite on the composition of experimental melts at 800 ^{o}C, 1035 ^{o}C, 600 ^{o}C (extrapolated) and natural Li-F granites.

The experimental results summarized in fig.1 demonstrate that columbite-tantalite solubility decrease with increasing ACNK in peralkaline liquids. It is also evident from the comparison of experimental results and log level of solubility products in natural, columbite-tantalite bearing granites (fig. 2) that solubility of these minerals do not increase in highly peraluminous (ACNK>1,8) melts.

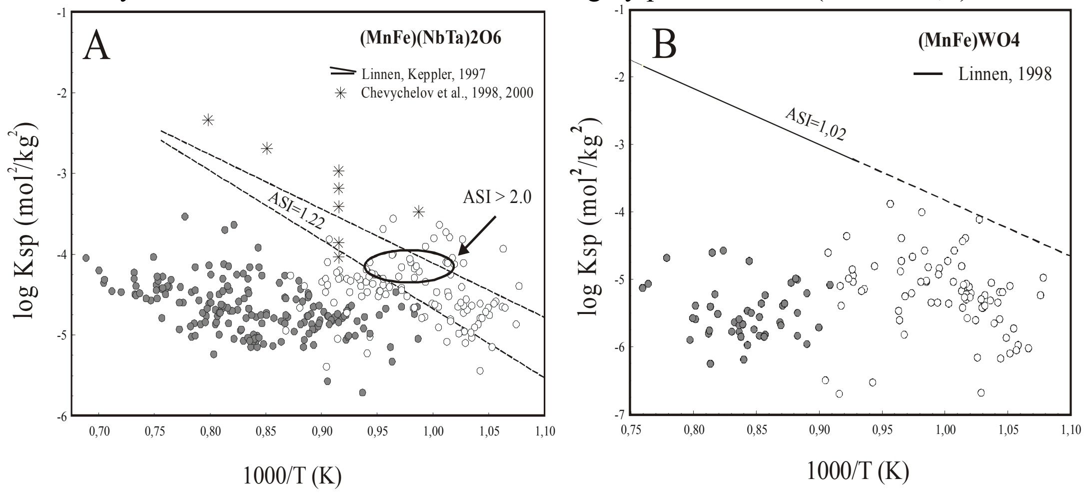

Fig.3. The temperature dependence of the log solubility products of columbite-tantalite (A) and wolframite (B) in the natural and experimental melts. The crystallization temperature for biotite (filled circles) and associated evolved Li-F granites (open circles) worldwide were calculated after taking into account the influence of fluorine.

The solubility behavior of columbite-tantalite (fig.3A) and wolframite (fig.3B) in the natural and experimental metaaluminous and peraluminous melts supports the idea that the main part of studied natural granites (biotite bearing varieties of Eibenstock pluton, W.Erzgebirge; Phuket supersuite, Thailand; Shumilovka, Orlovka plutons in Central Transbaikalia and Kharagul, Utulik plutons in South Transbaikalia, Kimy stock in Finland and some others) are undersaturated with respect to ore accessory minerals. Values close to saturation level correspond to the most evolved rare-metal granites associated with economically important Ta and W mineralization (Shumilovka, Etyka, Orlovka pluton, Transbaikalia; Beauvoir granites, French Massif Central; Yichun batholith, S.China).

Obtained results confirm the leading role of magmatic processes in rare metal accumulation during melt differentiation. Further combined experimental and empiric evaluation of the ore accessory mineral solubility in evolved highly peraluminous granitic melts would allow to identify the most important parameters crucial for the extreme concentration of rare metals in magmatic melts.

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