The nature of melt inclusions inside minerals in ultramafic cumulates from island arcs: implications for the origin of high-Al basalts

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In order to characterise the parental melts of crustal ultramafic cumulates from arc environments, I have undertaken a study of melt and fluid inclusions trapped in olivine and clinopyroxene crystals in a typical cumulate xenolith from Adak island, Aleutian Island Arc. The crystals contain inclusions either of silicate melts plus a H₂O-rich bubble or H₂O-dominated fluids, indicating H₂O saturation of the trapped melt during the entire course of its crystallisation. An experimental study of the silicate melt inclusions gives entrapment temperatures ranging between 940 and 1010°C. After homogenisation, the melt inclusions range in composition from basalt to dacite ; the Al₂O₃ and SiO₂ contents increase from 18.5 to 26.3 wt % and 47.1 to 56.4 wt % respectively, as MgO and FeO decrease from 6.5 to ~0.1 wt % and 6.5 to 0.3 wt %. The melt inclusions also have high levels of volatile elements (predominantly H_2O), ≥ 6 wt %. Comparison of the calc-alkaline compositional trend defined in the melt inclusion suite with experimentally determined multiply-saturated liquids of basalts indicate that the compositional variations in the melt inclusions reflect progressive crystallisation of an olivine + clinopyroxene assemblage similar to the host cumulate xenolith, at pressures \geq 3.0 kbar and H₂O-saturated conditions. Comparison between whole rocks from Adak island and the melt inclusion compositions supports the hypothesis that fractional crystallisation at moderate pressure of hydrous mafic basalts generates high-alumina basalt compositions and leaves large volume of ultramafic cumulate rock series in the crust beneath arc sections

AFM-examinations on the crystal growth of uranyl-oxide minerals on the surface of calcite

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The mineralogy and geochemistry of U have assumed considerable practical importance as society has begun to cope with the environmental issues arising from mining and milling of U ores and the disposal of U-based radioactive waste. This has led to a major increase in the amount of work done on the structure and paragenesis of U-minerals. Two of the most important groups of secondary uranium minerals are the uranyl-hydroxy-hydrate and the uranyl-hydroxy-carbonate minerals. These minerals mainly occur on corrosion rinds of primary uranium minerals (uraninite) and recently also on depleted uranium ammunition. Because uraninite is the natural analogue of waste nuclear fuel, the stability of uranylhydroxy-hydroxide and uranyl-carbonate minerals is relevant in the corresponding disposal sites. As those secondary Uphases dissolve, U-complexes in solution might migrate through rock and U-minerals precipitate on the surface of rock-forming minerals. In order to understand those crystal growth processes, we examined the interaction of $(UO_2)^{2+}$ solutions with calcite and the subsequent growth of uranyloxide minerals on its (1014) surface .All experiments have been carried out in-situ or in batch-experiments between 25 and 100°C and the corresponding dissolution and crystal growth mechanisms have been recorded with atomic force microscopy. Hereby, we observed epitaxial growth of uranylhydroxy-hydrate and uranyl-hydroxy-carbonate minerals such as schoepite, becquerelite, wyartite, andersonite and liebigite on the $(10^{1}4)$ surface of calcite. The oriented growth of these minerals is controlled by the arrangement of undersaturated Oatoms on the $(10^{1}4)$ surface of calcite and by the corresponding interstitial cations in the uranyl-oxide minerals.

Figure 1: Crystal growth of schoepite on the $(10^{1}4)$ surface of calcite.



Burns & Finch (1999), Reviews in Mineralogy, 38.