

Cr(OH)₃(s) oxidation coupled with heterogeneous Mn(II) oxidation

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Soil and groundwater contamination by Cr(VI) of natural origin has been reported over the world. Cr is 21st most abundant element in the earth's crust and commonly exists in the oxidation state of +III as a trace constituent of various aluminosilicate minerals. Under natural conditions, Cr(III) oxidaiton by dissolved oxygen or Mn oxides is thermodynamically feasible. Previous studies showed that Cr(VI) could be effectively oxidized by various Mn oxides under acidic conditions, but the oxidation became ineffective under neutral or higher pH conditions. This inhibition of Cr(III) oxidation was attributed to the precipitation of Cr(OH)₃(s) on the surface of Mn oxides, which blocks the reactive surface sites. Moreover, the oxidation of Cr(III) by dissolved oxygen is known to be kinetically sluggish and favorable only at high pH conditions. The geochemical processes causing the natural contamination of Cr(VI) have not been unveiled yet. This study examined whether Cr(OH)₃(s), which is the most common and stable solid phase of Cr(III) in the environment, could be oxidized indirectly by the product of Mn (II) oxidation. Although dissolved oxygen does not readily oxidize Cr(III), it effectively oxidizes Mn(II) heterogeneously under moderately alkaline pH conditions.

The suspensions were prepared with 1 g/L Cr(OH)₃(s) and/or 50 μM Mn (II) in 50 mM NaNO₃ at pH 7 – 9 in the presence or absence of dissolved oxygen. The solution pH was maintained with 10 or 50 mM buffers (MOPS for pH 7 and 8; CHES for pH 9). Under anaerobic conditions, Cr(VI) was not detected at all pHs regardless of the presence of Mn(II). Under aerobic conditions, Cr(VI) was released from Cr(OH)₃(s) oxidation both in the presence and absence of Mn (II) at pH ≥ 8. The amounts of Cr(VI), however, were substantially higher in the presence than absence of Mn(II) and increased with increasing pH. These results indicate that the rate and extent of Cr(OH)₃(s) oxidation would likely be controlled by those of heterogeneous Mn(II) oxidation.

Interaction between metamorphism and deformation in eclogite facies shear zones, Lofoten, Norway

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Eclogite facies shear zones in lower crustal rocks are argued to have formed by infiltrating fluids during eclogitization [1]. Weakening of the rocks is pronounced during shear zone formation [1]. Our study on eclogites from Lofoten [2], Norway deals with shear zones developed due to near isothermal decompression and subsequent symplectite formation. Mineral abbreviations are after Kretz [3]. Metamorphic Opx and Grt_I corona (M₁) at Ol – Pl interface characterize the undeformed eclogite. Alternate bands of mixture of Pl–amphibole (Amph) and Grt_I (M₁) – Opx – Omp (M_{2A}) characterize the shear zone (D₁). Recrystallized Opx grains and Cpx – Pl symplectite (M_{2B}) mantle Opx (D_{1A}) and Omp porphyroblasts respectively. Grt_{II} (M₃) occurs along the contact of deformed Opx and Pl. Amph (M₄) overgrows the finer grained pyroxene.

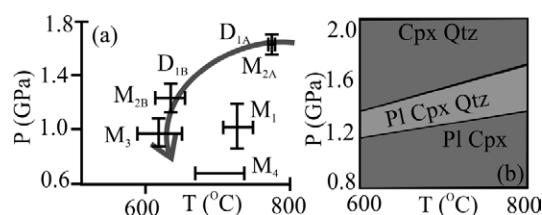


Figure 1: (a) PT estimate [GTB, 4] of different metamorphic stages. $Fe^{total} = Fe^{2+}$ is assumed for Omp. Shear zone PT path is also shown. (b) PT pseudosection [5] of reintegrated composition of Omp shows that exhumation is essential to generate fine-grained reaction products.

We suggest near isothermal decompression for the shear zone development in eclogite. The deformation of Opx and Omp commenced in the Omp stability field. Oriented inclusions of feldspar in Grt_{II} (M₃) indicate that shear zone developed before the Grt_{II} growth. This study reveals that fine-grained anhydrous reaction products can accommodate large amount of strains due to a decrease in grain size and a switch to diffusion creep deformation.

- [1] Austrheim (1987) *EPSL* **81**, 221–232. [2] Krogh (1977) *Nature* **267**, 17–19. [3] Kretz (1983) *Am. Min.* **68**, 277–279. [4] <http://ees2.geo.rpi.edu/spear/spear.html> [5] Connolly (2005) *EPSL* **236**, 524–541.