Did hydrothermal fluids contribute to the huge Úrkút Manganese ore body?

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Deposition of the black shale-hosted Úrkút Mn carbonate deposit in Hungary occurred in the Early Jurassic. The ore body formed in a structurally controlled marine basin via bacterially mediated, early diagenetic formation of Mn carbonates. It has been proposed that hydrothermal fluids venting into the depositional basin was involved in the mineralization, but this idea is controversial. A hydrothermal origin may be supported by several lines of evidence such as the fractionation of Mn and Fe, the in situ precipitation of celadonite and other clay minerals, and the accumulation of huge amounts of Mn, Fe, Si. However, none of this evidence alone or together for that matter are conclusive and the aim of this study is to look for evidence for a hydrothermal plumbing system by study of the underlying Mn- and Fe-oxide mineralization. Analysis of 12 samples show a wide range of Mn and Fe contents, with mean values of 35.9% Mn and 10.3% Fe. Si (4.9%), Sr (mean 0.6%), P (0.3%), Ba (0.3%) and Co (0.07%) are enriched in the Fe-Mn oxides. The Fe/Mn mineralogy of the samples is cryptomelane, todorokite, manganite, goethite, hematite, groutite. Polished thin sections show signs of bacterial activity and the precipitation of Mn oxides within soft carbonate sediment, sediment that was later partly to completely replaced by a later stage of Mn oxides. Sr and P enrichments reflect input from leaching of carbonates and organic matter. Mn oxide and Mn carbonate mineralization occur above a thick carbonate basement cut by deep fracture zones. Our data suggests that the Fe and Mn oxides were deposited from deep-sourced fluids circulating through basement rocks. Circulation along zones of structural weakness was likely driven by high geothermal gradients. Sr isotopes are being measured on these samples to confirm this idea.

Textural and microstructural analysis of rapidly grown omphacite from eclogite facies pseudotachylytes

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Rapidly grown omphacite (Jd40) has been formed in melt domains of an eclogitized gabbro from central Zambia by frictional melting during pseudotachylyte formation [1]. Omphacite occurs as an extremely fine-grained matrix (grain size of 2-3 µm) and form partly spherulites with diameters ranging from 100 to 300 µm. The textures point to fast mineral growth with local differences in nucleation and growth rate due to heterogeneous cooling. Here, omphacites within melt domains have been studied using electron backscatter diffraction (EBSD) and transmission electron microscopy (TEM) to relate mineral growth texture with deformation (dislocation) microstructure under eclogite facies conditions.

EBSD analyses of a single spherulite show a common *b* plane for all omphacite grains within the spherulite, while there is no lattice preferred orientation for matrix omphacite. The grains within the spherulite are significantly larger than in the matrix and form radially oriented needles. TEM revealed a strong deformation microstructure with subgrain boundaries, dislocation networks and nodes as well as stacking faults and associated partial dislocations. Grain boundaries of adjacent omphacites are often interlocked and wave-like curved. The spherulitic texture is obviously formed during growth. The distinct dislocation microstructure may have originated from the differential stress developing during rapid growth. Growth related deformation microstructures are barely studied yet and will be discussed in connection with eclogite facies pseudotachylyte formation.

References

[1] John, T., and Schenk, V. (2006) *Geology* **34(7)**, 557-560.