

Ore metals from the subcontinental lithospheric mantle?

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The hypothesis that the metals in some ore deposits come from the base of the lithosphere arises because we know very little about the composition of this part of the mantle. It could conceivably be enriched in certain metals, and if so, these metals could conceivably be transported to the surface in magmas or other fluids and there become concentrated in ore bodies. There is very little substance to the model, and many arguments against it. The lithosphere is by definition the coldest part of the mantle and it only melts under special conditions. The normal product is a low-degree melt - an alkaline, Si-undersaturated magma of the type that, with rare exceptions, contains few metallic ore deposits. Some gold deposits may be associated with lamprophyres that could have come from the lithosphere, but a direct genetic association has not been demonstrated. In regions of continent rifting, the lower parts of the lithosphere may well up and melt, but metallic ore deposits are rare in continental rift zones. Major magmatic ore deposits form from high-volume, high-flux magmas that result from high-degree melting in large volumes of mantle. The normal source of such magmas is in deeper, hotter parts of the mantle - the asthenosphere or a mantle plume. If melting is to occur in the lithosphere, rather than in the hotter parts of the mantle, the melting point of the lithosphere must be drastically reduced by the presence of volatiles. There is little evidence, however, that the host magmas of ore deposits were unusually rich in water or CO₂. Magmas from a sub-lithospheric source will interact with wall rocks as they pass through the lithospheric mantle and they may pick up some metals through this interaction. However, there is ample geological and geochemical evidence that the origin of most magmatic deposits involves crustal contamination of asthenosphere- or plume-derived magmas at shallow levels of the continental crust of magmas and that the major source of the ore metals is the asthenosphere or the plume.

Unexpected changes in aggregation and mineralogy of goethite during the reduction of nitroaromatics

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When studying the reduction of nitroaromatic compounds by ferrous iron in the presence of goethite, it is routine to use batch reactors. The ferrous iron and goethite are equilibrated in a pH-buffered solution, and the reaction is initiated by introducing a target contaminant in a cosolvent. These experiments have taught us much about the reactivity of nitroaromatic compounds in systems containing reduced iron, but there are two assumptions made in these systems. First, it is assumed that the particle size/surface area/aggregation state is constant. Second, it is assumed that the mineral phase composition does not change during the course of the reaction. We have previously shown that the particle size is not constant during such reactions [1]. Our results here reveal further limitations in the above assumptions.

Stable particle sizes are observed via dynamic light scattering (DLS) when goethite nanorods are suspended in a solution buffered with 3-(N-morpholino)propanesulfonic acid. Upon injection of a methanolic stock of 4-chloro-nitrobenzene, DLS measurements show rapid aggregation of the particles. Results to date suggest that the combination of cosolvent and contaminant lead to the agglomeration. This finding suggests that the method used to introduce the contaminant, including the presence of a cosolvent, may influence the measured reaction rate of the contaminant. These effects are beyond those caused by the buffer itself [2].

Results tracking the kinetics of trifluralin (a nitroaromatic herbicide) reduction in the presence of ferrous iron and goethite nanorods show surprising changes in particle agglomeration as well as phase composition of the solids. These results reveal a reaction system that is more dynamic than previously envisioned.

[1] Chun *et al.* (2006) *Environ. Sci. Technol.* **40**, 3299-3304.

[2] Danielsen *et al.* (2005) *Environ. Sci. Technol.* **39**, 756-763.