

Biom mineralization and biomimetic synthesis of magnetite nanoparticles

É. TOMPA¹, I. NYIRÓ-KÓSA¹, R. UEBE², D. SCHÜLER²
AND M. PÓSFAL¹

¹Dept. of Earth & Env. Sci., Univ. Pannonia, Veszprém, 8200 Hungary, (*correspondence: mihaly.posfai@gmail.com)

²Ludwig-Maximilians-Universität München, Dept. Biol. I, Biozentrum, D-82152 Planegg-Martinsried, Germany

Ferrimagnetic nanoparticles are used in a wide range of environmental, technical and medical applications, including their use for the transformation and degradation of metallic and organic pollutants, as constituents of magnetic fluids, and as contrast agents for magnetic resonance imaging [1]. Most applications require nanoparticles with highly specific physical properties. While magnetotactic bacteria produce magnetosomes (membrane-bound magnetite nanoparticles) with strictly controlled sizes and shapes, the regulation of these properties is typically much less successful in laboratory syntheses. By using the biom mineralization process in magnetotactic bacteria as a model system, we performed a series of biomimetic synthesis experiments in order to produce magnetic particles with strictly controlled properties.

First, the possible means of control over nanoparticle shapes were explored in abiotic precipitation experiments, by varying the iron source and/or the concentrations and types of organic additives. Depending on the applied conditions, octahedral, disk-like or elongated magnetite particles formed. We also analyzed magnetosomes from the magnetotactic bacterium *Magnetospirillum gryphiswaldense* and studied the effects of growth conditions and genetic modifications on the sizes, shapes and structures of magnetosome particles. Using the available information on the genetic background of magnetite biom mineralization in magnetotactic bacteria [2, 3], we designed a scheme for the bio-assisted synthesis of magnetic filaments. Mutagenized flagellar filaments were produced by inserting part of the gene of the known iron-binding protein Mms6 into the genome of *Salmonella typhimurium*. The mutagenized filaments are being used as stable protein scaffolds for the templated nucleation of magnetite, with the aim of producing magnetic ‘nanotubes’ [4].

[1] Laurent *et al.* (2008) *Chem. Rev.* **108**, 2064–2110. [2] Amemiya *et al.* (2007) *Biomaterials* **28**, 5381–5389. [3] Faivre & Schüler (2008) *Chem. Rev.* **108**, 4875–4898. [4] This study was supported by the EU-FP7 grant “Bio2MaN4MRI”.

Source Controls on the Metal Contents of Mantle-Derived Magmas

N. TONNELIER¹, C.M. LESHER² AND N.T. ARNDT³

¹ Department of Geology, University of Johannesburg, Johannesburg, South Africa

² Mineral Exploration Research Centre, Laurentian University, Sudbury, Ontario Canada

³ Institut des sciences de la Terre, Université de Grenoble 1, St. Martin d’Hères 38400 France

Plume-derived magmas are thought to form by melting of mantle peridotite source but recent studies have shown that ferropicrites and Hawaiian basalts have major and trace elements contents that cannot be explained by this model. Geochemical and petrological studies suggest that their compositions are best explained by melting of olivine-free pyroxenite that formed through reaction between peridotite and melts derived from recycled oceanic crust. Pyroxenite with these composition are minor but ubiquitous component in ultramafic massifs and mantle xenolith. Base and precious metals partition into sulfides, silicates and alloys, and their concentrations provide additional constraints on the lithology of their source. To test this hypothesis, we studied the Ni, Cu, Co, Zn, V, Sc and platinum group elements (PGE) contents of tholeiitic basalts and picrites from Hawaii and ferropicrites from Russia, Canada, and Namibia and compared their compositions with those of peridotite-derived magmas. Hawaiian basalts and ferropicrites have relatively low PGE with respect to Ni and Cu, a characteristic that has been previously attributed to a stage of sulfide saturation during magma ascent or the presence of sulfide in the residue of melting of a peridotite source. However, our study shows that Hawaiian basalts and ferropicrites are enriched in Ni-Co-Cu-Zn and depleted in Pd-Pt, but undepleted in Ru-Ir. These features are inconsistent with previous models but consistent with an olivine-free pyroxene-bearing source formed from recycled oceanic crust.

Our study show that a) the base and noble metal contents of mantle pyroxenite from Beni Boussera (Morocco) is consistent with mixing of eclogite-derived melts and peridotites, and b) the metal content of Hawaiian magmas and ferropicrites can be explained by melting of a mixed peridotite-pyroxenite mantle source. These observations have strong implication on the origin of magmatic ore deposits with mineralization characterized by high Ni-Cu tenors and high Cu/Pd and Ni/Ir ratios (e.g., Voisey’s Bay, Canada; Nebo-Babel, Australia; Eagle, USA, Jinchuan, Limahe, Lengshuiqing, Baimazhai, Jinbulake and Kalatongke, China).