

Subduction zones as probes of mantle composition

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On a global basis, the genesis of the majority of primitive island arc and backarc magmas is through partial melting of ultramafic parental lithologies in the mantle wedge overlying subducted lithospheric slabs. A combination of slab-derived, fluid-fluxed melting with some decompression melting are assumed to dominate these modes of magma genesis in current convergent margin settings.

The composition of arc-backarc magmas spans a large range, including rare earth- and high field strength element-strongly depleted low-K basalts, to highly enriched high-K basalts, plus a range of high-Mg, intermediate-Si magmas including boninites and high-Mg andesites. Abundant examples of active submarine eruptions of the latter types have been sampled in the past decade in the Tonga-Lau system. Their genesis involves fluid-fluxed partial melting of highly refractory, clinopyroxene-poor parental lithologies, probably at the high temperature end of the spectrum of backarc-arc-mantle wedge thermal regimes.

The addition of fluxing agents serves as a potent probe of the lithological heterogeneity of the mantle wedge that would not otherwise be subject to partial melting given refractory mineralogical characteristics. A spectrum of basalt-to-boninite magmas with high field strength and rare earth element abundances substantially lower than the majority of primitive mid-ocean ridge basalts, occurs widely in the intra-oceanic arcs of the western Pacific. Mixing of partial melts from refractory lithologies with those generated from more fertile protoliths also appears to be widespread in the western Pacific arc-backarc systems.

Another minor but widespread arc magma type is high-Ca-Mg “ankaramites”, possibly formed through partial melting of mantle wedge orthopyroxene-free wehrlite; this protolith likely originates as sub-Moho cumulates formed during fractional crystallisation of earlier generation hydrous arc magmas.

In contrast, alkali basalt magmas including very high-K types (some are phlogopite-phyric) hosting peridotite xenoliths, with high U/Nb typical of arcs generally, are rare magma types in the western Pacific arcs, but nevertheless indicative of the existence of highly metasomatised mantle wedge sources. The spectrum of mantle lithologies tapped during magma genesis at convergent margins is plausibly an excellent guide to the compositional variability of the upper mantle worldwide.

Aqueous contamination by oxyanions. The use of Zn-Al sulphate layered double hydroxides for waste water treatment

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Sorption is regarded as one of the most promising technologies for the treatment of waste waters, due to its efficacy and cost-effectiveness. Layered double hydroxides (LDHs) is a class of compounds with general formula $[M^{2+}_x M^{3+}_x(OH)_2](A^n)_{x/n}.mH_2O$. Possible cationic and anionic associations are widely variable (e.g. $M^{2+} = Mg, Zn, Cu$; $M^{3+} = Al, Fe$; $A^n = CO_3^{2-}, NO_3^-, SO_4^{2-}$). Thanks to their large surface area, and high anionic exchange capacity, LDHs are extensively investigated for their possible use as removers of pollutant oxyanions from waters.

LDHs form spontaneously in a wide range of environments, including mine areas. Zn-Al-sulphate LDHs were found to precipitate from surface waters interacting with mine wastes [1]. Their effectiveness in attenuation of As content in NAMD (Net Alkaline Mine Drainage), observed in natural systems, was the starting point of our investigation.

Synthetic Zn-Al-sulphate LDHs were reproduced in laboratory and tested in several batch sorption experiments, first for the uptake of As and, then, for less conventional environmental oxyanion pollutants (Mo, W and Sb).

The first results in the use of these LDHs as removers of pollutant oxyanions (up to ~90% As(V); up to ~54% Mo; W and Sb work in progress) encourage further investigations. Since the affinity for LDHs strictly depends on the combination of anion charge density and size [2], a key point for sorption efficacy is the anionic form of the investigated pollutant (e.g. $H_2AsO_4^-$, $HAsO_4^{2-}$ or AsO_4^{3-}), and of potential competitors in solution (e.g. HCO_3^- and CO_3^{2-}). For some of elements (Mo), possible polymerisation phenomena must also be considered (see also Davantès *et al.*, this issue). Therefore, the optimal pH conditions must be specifically evaluated for any oxyanion and waste water composition in order to enhance the LDHs uptake efficacy.

[1] Ardau *et al.*, (2011). *N. Jb. Miner. Abh.* **188/1**, 49–63. [2] Miyata S, (1983). *Clays Clay Miner.* **31 (4)**, 305–311.