Hf isotopes as the key for distinguishing slab melting in arcs: The case of the Mexican Volcanic Belt

STEVEN L, GOLDSTEIN[1], YUE CAI[1], CHARLES H. LANGMUIR[2], ALEXANDRA LAGATTA[1], SUSANNE M. STRAUB[1], ARTURO GÓMEZ-TUENA[3] AND ANA-LILLIAN MARTIN DEL POZZO[4]

[1]Lamont-Doherty Earth Observatory, Palisades, NY USA (steveg@ldeo.columbua.edu)
[2]Harvard University, Cambridge, MA USA
[3]UNAM, Querétaro, Mexico.
[4]UNAM, Coyoacan, DF, Mexico

Convergent margins are important as the global setting where crust is recycled into the mantle and new continent is made. Despite major advances in delineating the processes that control arc magma generation, the problem persists of distinguishing slab, mantle wedge, and crustal contributions, along with the question of whether there is significant melting of subducted ocean crust. Especially in thick crust regions, the importance of crustal versus mantle contributions to lavas represents a long-standing fundamental issue in arc magma geochemistry. We show, based on evidence from Hf isotopes, that frontal arc magmas from the Central Mexican Volcanic Belt (CMVB), including the large andesitic stratovolcanoes Popocatepetl and Nevado de Toluca, display negligible crustal contamination, and contain a component derived from melting of regional subducted oceanic crust plus sediments.

Despite thick continental crust, the CMVB erupts near primitive lavas including “high-Nb” alkaline basalts that show negligible trace element “subduction signatures”. The “high Nb” basalts define the regional mantle wedge composition in isotope-trace element space, and show well-defined Hf-Nd-Pb-Sr isotope “arrays”. In “normal” CMVB lavas with “subduction signatures”, a key feature is that they form trends from the “high-Nb” lavas toward even higher Hf isotope ratios, thus their sources are more “depleted mantle-like” than the regional mantle wedge. Of prime importance here is that higher Hf isotopes in these “normal” lavas correlate with low Lu/Hf and Pb isotope ratios.

These negative correlations can be simply modeled as mixtures of the regional mantle wedge, represented by “high-Nb” basalts, with a low degree composite melt of the subducted slab represented by altered Pacific ocean crust plus DSDP Site 487 sediment, located near the trench. Neither altered Pacific crust nor sediment by themselves explain the “normal” CMVB data, but the ocean crust component predominates. Thus, the integrated data allow us to clearly distinguish between mantle and crustal sources and point to substantial subducted slab melt contributions to these lavas.

It is fitting for a symposium that asks what have we learned from Hf isotopes that we don’t know already from Nd, that Lu-Hf provides key evidence identifying mantle signatures in a thick crust arc, and for distinguishing the slab melt contribution from other possibilities. These observations are also significant in the context of global arc data.

Relationships between magnetic properties and heavy metals in *Nerium oleander* leaves and soils (Viseu, Central Portugal)

C. R. GOMES[1,4], J. DIAS[4], L. NEVES[2,4], A. ROCHA[4] AND E. GOMES[3,4]

[1]CGUC, [2] IMAR, [3]CentroGeociênciasUC
[4]Department of Earth Sciences, University of Coimbra, Portugal (romualdo@ci.uc.pt)

Magnetic parameters (χ_{Lf}, ARM, IRM_{1T}) and selected heavy metals concentration (Cu, Fe, Mn, Zn, Pb, and Cr) of *Nerium oleander* leaves and topsoils were determined for 24 samples sites in the urban area of Viseu (Central Portugal). The purpose of this study is to relate magnetic properties to heavy metals concentrations and to assess the urban pollution levels. The table bellow presents some statistical information on the results obtained.

Variables (units)	Topsoils			Leaves		
	n	Min-Max	Mean	n	Min-Max	Mean
χ ($10^{-8}m^3kg^{-1}$)	23	44.9-141.9	78.4	27	2.3-193.2	51.6
IRM ($Am^{-1}kg^{-1}$)	23	155.5-878.8	391.9	27	4.7-120.9	31.3
ARM ($Am^{-1}kg^{-1}$)	23	4.5-39.8	12.3			
Fe (mg/kg)	23	17800.0-61400.0	37239.1	27	207.1-1396.5	766.0
Mn (mg/kg)	23	258.0-833.6	455.5	26	37.7-231.6	108.7
Cr (mg/kg)				27	0.3-6.8	3.3
Zn (mg/kg)	23	18.7-499.9	184.4	27	34.2-126.5	67.7
Cu (mg/kg)	23	19.7-164.8	66.3	27	9.4-44.1	23.4
Pb (mg/kg)	23	16.2-149.0	62.7	24	0.2-2.5	1.2

Significant correlations were found between most chemical elements and magnetic parameters determined in leaves. This is confirmed by a factor analysis, where the dominant factor (60% of the total variance) shows only positive contributions including both physical and chemical parameters (Cu, Fe, Mn, Pb, Zn, magnetic susceptibility, and IRM). The second factor (18% of the total variance) shows positive contributions of Fe and Cr and negative of IRM and magnetic susceptibility. Communalities are higher than 0.82, with the exception of Mn (0.44) and Pb (0.65). The same pattern was observed for topsoils. Again, chemical and magnetic parameters are related with significant correlations and a factor analysis shows positive contributions of all of them to the most important factor (49% of the total variance). The second factor (25% of the total variance) shows positive contributions of ARM and Fe and negative contributions of Pb and Zn. Communalities are all higher than 0.55 and most exceed 0.75.

These results indicate that factor 1 in both cases is clearly related to contamination induced by anthropogenic activities and that magnetic parameters of leaves and soils can be used as an indicator of the degree of chemical contamination and pollution levels. Factor 2 is probably related to natural variations of the composition of leaves and topsoils.