5.3.12

The subduction blender – the role of slab-derived hybrid rock-types for volatile and trace element recycling in subduction zones

C.J. SPANDLER[1], J. HERMANN[2], R.J. ARCULUS[1] AND J.A. MAVROGENES[1,2]

[1] Department of Earth and Marine Sciences, Australian National University, Australia (carl@geology.anu.edu.au)
[2] Research School of Earth Sciences, Australian National University, Australia

The fluxing of H_2O, CO_2 and trace elements through subduction zones is one of the most important geochemical cycles on Earth. Volatile components released during progressive metamorphism of subducting oceanic crust are thought to cause melting of the overlying mantle wedge, producing arc magmas. The petrological evolution and devolatisation of the principle components of subducting slabs (MORB, sediments, serpentinite) are now well constrained. However, volatile and trace element flux through subduction zones remains highly contentious. The blueschist to eclogite-facies Pouebo Terrane of northern New Caledonia represents oceanic crust that was previously subducted to depths of ~60 km. Within the terrane are high-pressure melange zones consisting of a range of mafic, metasedimentary and ultramafic lithologies that have been strongly sheared and intermixed. These melange zones have been observed on sub-metre to kilometre scales and comprise a significant proportion of the terrane. The melanges contain hybrid rock-types, such as carbonate-rich talc and chlorite schists, that are not equivalent to any protolith at the Earth's surface. Using field relations, bulk-rock geochemistry and oxygen isotopes, we suggest that these hybrid rocks formed during subduction by metasomatism and mixing of serpentinites, mafic rocks and metasediments.

Subducted mafic rocks and serpentinites may deliver H_2O to sub-arc depths, but fluid release occurs at temperatures too low (>600 ˚C) to dissolve significant amounts of the slab-sourced elements that are found in arc magmas. Hybrid rock-types may comprise a significant proportion of subducting slabs and have the potential to transport large amounts of volatiles to sub-arc depths. Talc and chlorite-rich hybrid rocks will undergo dehydration at relatively high temperatures (~ 800 ˚C) allowing for elevated element solubility in fluids or partial melting of adjacent pelitic rocks. By contrast, carbonates and magnetite in these rocks are stable to very great depths and may be important for recycling some trace elements (REE, HFSE) into the deep mantle. Therefore, hybrid rock-types in subducting slabs may be critical for element and fluid recycling through subduction zones and the evolution of arc magmas.

5.3.13

Source compositional variability beneath the Bicol arc, the Philippines

F. MCDERMOTT[1], F.G. DELFIN JR[2]., M.J. DEFANT[3], S. TURNER[4] AND R. MAURY[5]

[1] Department of Geology, University College Dublin, Belfield, Dublin 4, Ireland (frank.mcdermott@ucd.ie)
[2] School of Policy, Planning and Development, University of Southern California, Los Angeles, CA 90089, USA
[3] Department of Geology, University of South Florida, Tampa, FL 33620, USA
[4] Department of Earth and Planetary Sciences, Macquarie University, Sydney, NSW 2109, Australia
[5] Laboratoire de Petrologie et UA 1278, Universite Bretagne Occidentale, 29287 Brest, France

Pliocene to Recent volcanic rocks from the Bulusan Volcanic Complex (BVC) in the southern part of the Bicol arc (Philippines) exhibit a wide compositional range (medium- to high-K basaltic-andesites, andesites and a dacite/rhyolite suite), but are characterised by LIL element enrichments and HFS element depletions typical of subduction-related rocks. They exhibit relatively low $^{87}Sr/^{86}Sr$ ratios (0.7036-0.7039) compared with most volcanics from the Philippine archipelago. Their Pb isotope ratios are also unlike those for other Philippine arc segments and typically plot within and below the data field for the Philippine Sea Basin, implying a pre-subduction mantle wedge similar to that sampled by the Palau Kyushu Ridge (PKR), east of the Philippine Trench. $^{143}Nd/^{144}Nd$ ratios are moderately variable (0.51285-0.51300), and samples with lower $^{143}Nd/^{144}Nd$ tend to have high Th/Nd, high Th/Nb and low Ce/Ce* ratios. Unlike some other arc segments in the Philippines (e.g. the Babuyan-Taiwan segment of the Luzon arc) there is little evidence for the involvement of subducted terrigenous sediment. Instead, the moderately low $^{143}Nd/^{144}Nd$ ratios in some of the Bicol volcanics appears to result from subduction of pelagic sediment (low Ce/Ce*, high Th/Nd and high Th/Nb) and its incorporation into the mantle wedge as a partial melt. Apart from one sample that exhibits recent Th enrichment, the U-series results indicate minimal recent subduction-related U enrichment ($^{230}Th/^{238}U$) = 0.96-0.99). Two samples of historic lavas (1968 and 1984) from the Mayon volcano exhibit moderately high ($^{226}Ra/^{230}Th$) ratios indicating recent Ra enrichment and rapid transit of the magmas to the surface.

.