Geotectonic Aspects of Orogenic Volcanism

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Orogens or zones of the plate convergence show a great variability of style in respect of the plate's character and their relative motion. The variability of style is reflected in the variability of volcanic phenomena, which is directly related to processes in the mantle and deep crust.

The most common model of orogenic volcanism relates volcanic activity to the contemporaneous subduction of "oceanic crust". Primary magmas are in this case generated by partial melting of metasomatized mantle above the subduction zone. Volcanic rocks are generally of the calc-alkali composition. However, a significant variability from low-K to high-K suites has been observed across volcanic arcs and in the succession from oceanic arcs to continental margins. Bimodal andesite/rhyolite suites are characteristic of evolved arcs and continental margins.

Each subduction is eventually concluded by the slab detachment during arc/continent or continent/continent collision. The slab detachment accelerates compensating asthenospheric flow, creating conditions for an increased rate of magma production, respectively for partial melting of metasomatized lithospheric mantle. This mechanism of magma generation is important especially in the case of subduction in narrow elongated oceanic domains, e.g. in the Alpine orogen. Rocks are generally of calc-alkali composition, often of high-K and/or adakite type.

A specific case represent orogens with active back arc extension. Related stretching of lithosphere is compensated by the asthenospheric mantle upraise. This upraise, if extensive enough, causes decompression partial melting, producing a variety of volcanic rocks depending on the degree of partial melting and asthenospheric composition. A low degree of partial melting during the early stage of back arc extension creates alkali basalts, that are replaced by olivine tholeiites and MORB type basalts during transition to the newly formed back-arc basin. In the case of the back arc extension in the region of continental crust, basalt magmas are subject to underplating, creating conditions for generation of anatectic rhyolite magmas and characteristic bimodal basalt/rhyolite volcanism.

If the back arc extension affects asthenospheric mantle metasomatized by previous subduction processes (like is the case in the Carpatho-Pannonian region) volcanic rocks will be of the calc-alkali and/or adakite composition. A thick continental crust in the area of the back arc extension causes an early underplating and generation of anatectic rhyolite magmas. Later, as the crust is thinned progressively owing to the extension, rhyolite volcanism is substituted by the bimodal andesite/rhyolite association.

A specific geotectonic regime of the orogen is the late stage relaxation and/or orogenic collapse, generally associated with the extension environment and thermal rejuvenation. Mantle derived magmas invade orogen roots, giving rise to slightly alkali anatectic magmas (late orogenic A-type granites). Further evolution towards rifting and related bimodal volcanic activity is possible.

Li Isotopic Composition of Planktonic Foraminiferal Tests and their Host Sediments from ODP 926A

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There are two major sources of oceanic Li: river input derived from weathering of the continental crust (δ^6Li = −6 to −32 ‰; Huh et al., 1998) and Li introduced by hydrothermal fluids derived from high-temperature alteration of MORB (δ^6Li = −9 ‰). Provided that the Li mass balance and isotopic composition of MORB can be constrained, the isotopic composition of Li in sea water is a potential tracer of weathering processes on the continents. It has been suggested that Li isotopic composition of foraminiferal carbonate can be used as a proxy for the composition of the modern and past ocean water (Košler et al., 2001).

Herein we present Li isotopic data from 1–10 mg samples of fossil planktonic foraminiferal tests of *Pulleniatina obliquiloculata, Orbulina universa, Globoquadrina venezuelana* and *Globigerinoides sacculifer* and their host sediments collected from the ODP hole 926A at Ceara Rise. The samples were taken from 32.5 to 304.5 mbsf, corresponding to ages of 1.8 to 15.8 Ma (Pleistocene to Middle Miocene). The samples of foraminifers were crushed to break open the chambers and ultrasonically and chemically cleaned prior to dissolution to avoid contamination of foraminiferal carbonate by the host sediment. Isotopic composition of Li was measured by quadrupole ICP mass spectrometer in 2% HNO_3 with a within-run precision better than 1 ‰ and long-term reproducibility better than 2.1 ‰.

The Li isotopic composition of Recent foraminiferal tests corresponds to the composition of modern ocean water (−32 ‰ δ^6Li). The composition of fossil tests and their host sediments from ODP 926A varies from ca −30 to −15 ‰ and from 0 to +5 ‰, respectively. Our data suggest no significant isotopic equilibration of Li between the foraminiferal carbonate and the sediments over the period of the past 14 m.y. The variations in Li isotopic composition in planktonic foraminifers during the past 14 m.y., and especially the shift from −20 ‰ to −32 ‰ δ^6Li in the last 4 m.y., are interpreted as resulting from a progressive change in the mechanism of continental weathering.

References

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New Progress in Deciphering Structural and Metamorphic Evolution of the Vepor Basement in West Carpathians

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The Vepor basement represents the inner Variscan zone of Central West Carpathians. It is mainly composed of micaschists, orthogneisses and heterogeneous para- and ortho-derived migmatites intruded by porphyritic to medium-grained peraluminous granites. The emplacement ages of granites and cooling ages of basement rocks are mostly Variscan (370–300 Ma, U/Pb and 346–377 Ma, Ar/Ar Amp–amphibolites, respectively). The basement rocks exhibit high-grade fabrics represented by compositional layering and stromatitic banding in migmatites.

The Variscan fabrics are affected by two main Alpine tectonic events. The older extensional phase results in the development of subhorizontal mylonitic foliation generally dipping to the ESE, bearing eastward-dipping stretching lineation. The extensional mylonitic foliation exhibits metamorphic and deformational gradient marked by temperature increase from east to west and from top to bottom, whilst the intensity of deformation increases in opposite direction. These phenomena are marked by the development of anastomose network of small-scale shear zones in deeper parts of the massif passing to homogeneous mylonitic reworking in a large-scale normal shear zone in the uppermost part. The temperature gradient was determined mainly by microstructural criteria, i.e., recrystallization mechanisms of individual phases and products of plagioclase destabilization.

The subsequent compressional event is documented by the development of new cleavage planes steeply dipping to the south and north with lineations and fold hinges slightly plunging to the northeast. This deformation heterogeneously affected the Vepor basement and is developed predominantly in two major zones: the Pohorelá shear zone in the north and the Korimovo shear zone in the south. Both zones are developed in zones of weakness marked by the presence of micaschists and paragneisses.

The structural, microstructural, compositional and EBSD textural data are presented to distinguish the Variscan amphibolite-facies fabrics from the Alpine upper-greenschist ones. In addition, optically measured biotite textures from microstructural–metamorphic zones are used to determine the orientation tensor to examine biotite CPO contribution to the AMS fabric pattern.

Variscan Foreland Fold-Thrust Belt of Wielkopolska (W Poland): New Structural and Sedimentological Data

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Variscan externides of Wielkopolska comprise an entirely concealed succession, at least c. 2500 m thick, of Carboniferous clastic sediments folded and thrust before the Permian. Their subcrop zone extends over a considerable area of central western Poland and is the eastern continuation of the Rhenohercynian Zone of Germany. The Carboniferous succession of Wielkopolska consists of fairly monotonous series of turbidites consistently interpreted as flysch. It was deposited during