

Zircon U-Pb ages of porphyroids of the Peloritan Mountains (NE Sicily): constraints on the pre-Variscan evolution of the Peloritan microplate

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A petrographic, geochemical and geochronological study has been undertaken on a metavolcanic suite interbedded in the Palaeozoic metapelitic sequence of the crystalline basement of the Peloritan Mountains (Sicily) to decipher the pre-Variscan geodynamic evolution of the Peloritan microplate. Acid metavolcanics (porphyroids) are widespread in the Variscan belt and are an important element of the Peloritan area.

The suite consists of two main groups of volcanic rocks: 1) MF type, green massive metavolcanic rock with intermediate chemical composition; 2) P type, porphyroids having a silica range from 72 to 76 %. The most reliable classification of the protolith is provided by the diagram Nb/Y vs Zr/TiO₂ where the MF type metavolcanics fall in the field of rhyodacites and dacites, while the porphyroids are classified mainly as rhyolites.

Trace element signatures have been employed to put some constraints on the possible tectonic setting in which the Ordovician volcanism developed. The Ocean Ridge Granite normalised patterns have a shape which fits well with volcanic arc and/or collisional granites patterns.

TIMS-ID U-Pb analyses were obtained on single and multi-grain zircon fractions from four samples of P type and one sample of MF type. The results are tightly clustered on or near Concordia giving ages in the range between 455-460 Ma. The consistent morphological characteristics and the internal structures showing primary oscillatory zoning indicate a single stage magmatic crystallization. Although slight younging effects caused by Pb loss can't be excluded, the consistency of the data strongly supports formation of the units in the Upper (to Middle) Ordovician.

One of the units contains xenocrystic zircons with ages of 1150 and 2015 Ma indicating that the Peloritan area developed upon a cratonic basement characterised by both Grenvillian and Transamazonian crustal components.

In synthesis, the geochemical and geochronological evidence that Peloritan area formed as an Upper/Middle Ordovician volcanic arc on a basement of Gondwanan affinity allows us to support the hypothesis of an Ordovician orogenic event and to correlate it with other segments now widely dispersed in the Variscan orogen.

Rapid diagenesis in bone mineral: Mechanisms and applications

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The trace element chemistry of living bone is determined by the trace element composition of the animal's food and water – and physiological (vital) effects. Many attempts have been made to use the trace element (and stable isotope) chemistry of bone to reconstruct aspects of the diet or environment of ancient people and animals.

Bone is composed of extremely unstable, reactive crystallites, however, which interact rapidly and extensively with pore waters, so that the trace element composition of bone soon reflects diagenetic rather than biogenic signals. In this talk we show the effect of up to 30 years exposure on the size, shape and crystallinity of apatite crystallites, and associated increases in trace metal content. We then show how the trace metal composition of fossil bones can be used to reconstruct site environment.

Amboseli bone collection

Bone samples were taken from carcasses weathering on the Amboseli plain, S Kenya. Carcasses were first located and sampled in 1975, and then sampled periodically until 2001 (AKB). The total duration of exposure ranges from 40 years to 15 years. Crystallinity was determined by FTIR spectrometry based on splitting of the phosphate couplet. Bone crystallites were disaggregated, dispersed and imaged by TEM, and average crystal dimensions calculated from populations of at least 100 single crystals. Crystallinity increased in the 15-40 years of exposure, and was associated with increases in mean crystallite size, and particularly in changes in crystal shape. Crystal change is also associated with breakdown of collagen monitored by FTIR and TGA analyses. These mineralogical changes were associated with 2-10 fold increases in adsorbed trace metal (REE) contents (determined by ICP-MS). Alteration of bone chemistry occurs immediately upon exposure, and increases in trace metal content are associated with disruption of the collagen-apatite association in fresh bone, and subsequent changes in crystal form driven by the metastable nature of bone apatite crystallites.

Fossil bone collection.

We also determined REE contents in 350 fossil bones from the Pleistocene Olorgesailie Fm, Kenya. Bones were distributed across two palaeosols, each palaeosol representing approximately 1000yrs. The REE pattern of bones recovered from both soils reveals spatial (meter scale) and temporal (1000yr scale) differences in environmental conditions, that most likely reflect differences in hydrology and organic content in pore waters. These differences correlate with independent measures of environmental characters (e.g. clay mineralogy) and may have implications for reconstructions of hominid land use strategy.

In summary, bone mineral is rapidly altered upon exposure, and inherits a trace element signal that is controlled by the chemistry of the local environment of burial. This