Hercynian gabbroic intrusions from the Spanish Central System: Constraints on mantle composition under central Spain

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Small basic to intermediate intrusions are scarce within the Spanish Central System (SCS), outcropping among abundant coeval peraluminous granitoids. Although mixing with granite magmas is very common, in this study we only deal with the most primitive basic rocks. They range from norites to olivine gabbro-norites, with some Amph-Phl-rich varieties.

Major and trace element composition suggests a low degree of magma differentiation (Mg# = 0.52-0.75; Cr = 96-1170 ppm), though some Cr-Spl + Ol fractionation might have occurred. K_2O content is in the range 0.73-2.82 wt% and a medium-K to high-K calc-alkaline affinity is observed. Their sub-alkaline nature argues against their inclusion in the appinite suite, as previously suggested.

Although two groups of gabbros may be distinguished according to LILE-U-Th concentrations, these rocks show high LREE and LILE concentrations in general, indicative of an enrichment event in the mantle source. Their chondrite and primitive mantle normalised multielement plots show negative Nb, Ta and Ti anomalies and positive Pb anomalies, suggesting involvement of subduction-related fluids or crustal recycling. These patterns resemble those of continental arc-related gabbros, but with lower Ba-Sr contents.

Their Sr-Nd isotopic signatures display a slightly enriched composition close to BSE (εNd = -2.6 to 0.7; $^{87}Sr/^{86}Sr$ = 0.7045-0.7063). This is also shown by other SCS gabbroic intrusions (e.g. Bea *et al.*, 1999). The short isotopic compositional range suggests the lack of significant crustal assimilation during emplacement. Pb isotope ratios of gabbros also define a small compositional field, similar to SCS granitic rocks. The presence of two gabbro types might be related to variable mineral modes in the mantle sources.

The late-Hercynian mantle under central Spain has been proved to show an heterogeneous composition (Villaseca *et al*., 2004). This new dataset reinforces that conclusion and points to the involvement of a recycled crustal component into their mantle sources.

References

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The ties that bind: Dynamics of syntrophic associations in marine methane seeps

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The deep-sea methane seep environment supports active and diverse microbial assemblages supported by the anaerobic oxidation of methane (AOM). Unknown to science less than a decade ago, the microorganisms and the molecular mechanisms underlying this enigmatic and globally important biogeochemical process have been the subject of intensive study worldwide. The identification, activity, distribution, and partial metabolic pathway reconstruction of methanotrophic archaea and co-associated sulfate reducing bacteria has been characterized. However fundamental questions still remain regarding the necessity of a physically coupled syntrophic association between sulfate reducing bacteria and methane oxidizing archaea, the underlying biochemistry enabling sulfate-coupled methane oxidation, and the extent of the diversity of microbial assemblages involved in AOM. Using microanalytical stable isotope analyses of whole cells in tandem with genomics enabled molecular methods, we examined the variation in metabolic activity between individual aggregations of microorganisms recovered from methane seep sediments. Significant differences in activity were observed between archaeal-bacterial associations and mono-specific aggregations of putative methanotrophic archaea and sulfate-reducing populations, supporting enhanced metabolism in multi-species aggregates. Application of a new SSU rRNA targeted method for capturing and concentrating specific uncultured microbial populations from methane seep sediments has uncovered novel partnerships and additional insights into the metabolic potential of the methanotrophic archaea and co-associated bacteria.