HF-ND ISOTOPE CORRELATION IN THE QUATERNARY POTASSIC MAGMATISM FROM CENTRAL ITALY: NEW EVIDENCE OF OCEANIC CRUST CONTRIBUTION TO THE MAGMA SOURCE

Daniela Gasperini*,, Janne Blichert-Toft***, Francis Albarède***, Aldo Del Moro**** and **Patrizia Macera*,****

** Dipartimento di Scienze della Terra, Università di Pisa, via S. Maria 53, 56126 Pisa, Italy.*
*** C.N.R.- Istituto di Geocronologia e Geochimica Isotopica (IGGI), via Cardinal Maffi 36, 56127 Pisa, Italy.*
**** Ecole Normale Superieure (ENS-Lyon), 46 Allee d'Italie, 69364 Lyon Cedex 07, France.*

ABSTRACT

Pleistocene potassic and ultrapotassic primitive lavas and scorias (basanites, trachybasalts, basalts, phonotephrites and shoshonites) from different representative volcanic centers of the Roman Magmatic Province (RMP: Vulsini, Vico, Sabatini, Ernici), the Tuscan Magmatic Province (TMP: Cimini, Radicofani) and Sardinia (Logudoro) were collected. Nd and Hf isotopes were analysed in 27 very fresh samples using TIMS in Pisa and plasma-sector mass spectrometry in Lyon respectively. The Hf-Nd isotopic composition of the samples belonging to the RMP ranges from -0.28 (Ernici) to -8.11 (Vico) ε_{Hf} and from -5.48 (Ernici) to -10.53 (Vico) ε_{Nd}. In the TMP, the Cimini sample shows the lowest Hf-Nd isotope ratios ($^{176}Hf/^{177}Hf$ = 0.282446; $^{143}Nd/^{144}Nd$ = 0.512055) while all the other rocks fall within the range of the RMP. Sardinian samples are characterized by ε_{Hf} = -2.48 to -4.58 and ε_{Nd} = -3.29 to -4.28.

For a given Nd isotopic composition, all the samples from central eastern Italy are characterized by Hf isotope ratios that are significantly more radiogenic that what was usually found in most mantle-derived volcanic rocks and crustally-derived granites (Vervoort et al., 1998). In a εHf-εNd isotope space (Fig. 1), the compositions of the volcanics from the RMP and TMP plot above the Hf-Nd isotopic mantle-crust array, below the newly identified field of Mn-nodules (Albarède et al., 1998) and within the field of pelagic sediments (Vervoort et al., 1998). Therefore the Hf-Nd isotopic properties of these rocks signal a significant contribution of pelagic material to their source, whereas this component cannot be clearly resolved in Sr-Nd isotope space. Actually, with regards to a given Nd isotope ratio, radiogenic Hf isotopic composition in primitive rocks can be explained with the presence of Hf-Zr poor material in their source, that is to say with a lacking zircon content. Because of the physical properties of zircon, which due its heavy weight is unlikely to be transported by wind or suspended clay across ocean basins (Vervoort and Blichert-Toft, 1998), this material should reflect pelagic component.

We suggest that the volcanics from the Roman and the Tuscan Magmatic Provinces formed with the contribution of the remelting of an oceanic crust component in which both the altered basaltic layer and its pelagic sediment veneer can be identified by radiogenic and stable isotopes (Turi and Taylor, 1976), as well as trace elements. It is likely that the isotopic signature was acquired far enough away from a terrigenous source for the pelagic component not to have become entirely diluted by terrigenous sedimentation and therefore points to an open ocean environment. Whether this pelagic component is actually present in the source or has been transported into the subcontinental mantle by suduction-related metasomatism is speculative, but we consider that metasomatic transport is not necessarily required by the data.

Origin of the central Italy potassic magmas by melting of mantle that had incorporated slivers of "dirty" oceanic lithosphere by unknown geodynamic processes stands as the best interpretation of the present isotopic data.

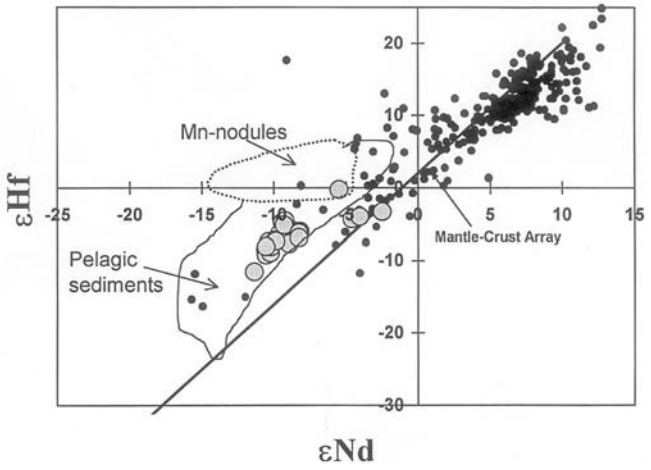

Fig 1 - Plot showing ε_{Hf}-ε_{Nd} correlation in the Quaternary potassic magmatism from central Italy.
(• Mantle: literature and Blichert-Toft unpublished data; ○ Central Italy: this work; Mn-nodules field: Albarède et al., 1998; Pelagic sediments field: Vervoort et al., 1998).

REFERENCES

Albarède F., Simonetti A., Vervoort J., Blichert-Toft J. and Abouchami W., 1998. Hf-Nd isotopic correlation in ferromanganese nodules. Geophys. Res. Letters, 20: 3895-3898.

Turi B. and Taylor H.P. Jr., 1976. Oxygen isotope studies of potassic volcanic rocks of the Roman Province (central Italy). Contrib. Mineral. Petrol., 55: 1-31.

Vervoort J., Patchett P.J., Blichert-Toft J. and Albarède F., 1998. Relationship between Lu-Hf and Sm-Nd isotopic system in the global sedimentary system. Earth Planet. Sci. Letters. In press.