Early mantle composition and evolution inferred from ^{142}Nd and ^{182}W variations in Isua samples

H. RIZO*[1,2], M. TOUBOUL[2], R.W. CARLSON[1], M. BOYET[3], I.S. PUCHTEL[2] AND R.J. WALKER[2]

[1]Carnegie Insitution of Washington, Dept. of Terrestrial Magnetism, Washington DC 20015, USA.
[2]University of Maryland, College Park, MD 20742, USA
[3]Universite Blaise Pascal, 63038 Clermont-Ferrand, France
*Correspondence: hrizo@ciw.edu

The composition and evolution of the early terrestrial mantle is largely unknown due to the sparse geological record preserved from Earth's infancy. The short-lived ^{146}Sm-^{142}Nd chronometer applied to Eoarchean Greenland rocks led to the discovery of the oldest known mantle reservoir. Samples derived from this reservoir have ^{142}Nd excesses of 10-20 ppm compared to modern samples, which combined with ^{147}Sm-^{143}Nd systematics suggest that their source was depleted in incompatible elements, and formed in the first 150 Ma of Solar System history [1-4]. Recently, ^{182}W excesses of ~+13 ppm relative to terrestrial standards were also detected in rocks from the same area [5], as well as in the mantle sources of 2.8 Ga komatiites [6]. ^{182}W excesses could reflect imperfect mixing of late-accreted materials into the mantle during the period between 4.5 and 3.8 Ga. Given the short half-life of ^{182}Hf, these excesses could instead reflect Hf/W fractionations during the first tens of Ma of the Solar System history. In this case, ^{182}W and ^{142}Nd signatures would indicate that early-formed mantle reservoirs were not erased during the Moon-forming giant impact. Re-mixing of early-formed Greenland reservoirs likely started during the Hadean and the obliteration of these heterogeneities with respect to ^{142}Nd seems to have been completed by 3.3 Ga [7], whereas the ^{182}W anomalies detected in 2.8 Ga komatiites imply that W isotopic heterogeneities persisted in the mantle until at least the late Archean [6]. We present new highly siderophile element and ^{182}W data for 3.8 Ga to 3.3 Ga old Isua samples, previously analyzed for ^{142}Nd. This dataset may help constrain the composition of the Archean mantle as it evolved through time, and may allow modeling the mixing rate of late accreted meteoritic material in the mantle.

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Noble gases geochemistry of magma degassing at Santorini (Greece): Inferences on 2011-2012 unrest

RIZZO A.[1], BARBERI F.[2], CARAPEZZA M.L.[3], FRANCALANCI L.[4], D'ALESSANDRO W.[1], DI PIAZZA A.[2] AND SORTINO F.[1]

[1]Istituto Nazionale di Geofisica e Vulcanologia, Sezione di Palermo, Via Ugo La Malfa 153, 90146 Palermo, Italy
[2]Dipartimento di Scienze, Università di Roma Tre, Largo San L. Murialdo 1, 00146 Roma, Italy
[3]Istituto Nazionale di Geofisica e Vulcanologia, Sezione di Roma1, Via di Vigna Murata 605, 00143 Roma, Italy
[4]Dipartimento di Scienze della Terra, Università degli Studi di Firenze, Via La Pira 4, 50121 Firenze, Italy

We performed a noble gases investigation of fluid inclusions hosted in olivines and pyroxenes from mafic enclaves contained in the 1570 and 1925 A.D. dacitic magmas erupted at Nea Kameni. These enclaves are a portion of mafic magma batches that replenished the shallow chamber of the plumbing system hosting cooler and more silicic melts. Their Sr-Nd isotope ratios are quite similar to those measured in the host dacitic rocks, implying a common parental magma. Therefore, the analysed enclaves may be considered representative of the historic magma erupted at Nea Kameni which could be still present in the volcano plumbing system feeding the crater fumaroles.

Gases extracted from fluid inclusions are affected by an appreciable air contamination, as their ^{4}He/^{20}Ne and ^{40}Ar/^{36}Ar ratios are near to the typical atmospheric signature. The ^{3}He/^{4}He ratios of olivines, once corrected for air contamination (3.1-3.6 Ra), show higher and more reliable values than the cogenetic pyroxenes. These values partially overlap those of the gases (3.5-4.0 Ra) collected from Nea Kameni fumarolic field and from bubbling springs at Palea Kameni. The range of ^{3}He/^{4}He ratios (3.1-4.0 Ra) is appreciably lower than typical arc volcanoes (R/Ra ~7-8), implying that a contamination by ^{4}He-rich fluids occurred either directly in the mantle and/or in the plumbing system. Comparison of ^{3}He/^{4}He and ^{4}He/^{40}Ar* ratios measured in enclaves with those of fumarolic gases, as well as long-term monitoring of R/Ra in the latters, coherently indicate that magma involved in the 2011-2012 unrest is likely more primitive and ^{3}He-rich than the mafic enclaves. This would imply that the Santorini magma presently available for eruption has a lower explosive potential than in the recent historic eruption of Nea Kameni.

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