Hydrogen isotopic composition of Earth's early ocean estimated from Archean MORB in Barberton Greenstone Belt

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Origin and evolution of Earth's seawater are still poorly understood. Hydrogen isotopic composition is a key to constrain secular change of seawater volume through time. In Barberton Greenstone Belt, South Africa, the past fragment of Archean oceanic crust is well preserved. We have systematically analyzed hydrogen and oxygen isotopic compositions of sub-greenschist facies pillow basalts in upper part of the Hoogenoeg Complex. Based on petrographic observation together with XRD analysis, almost hydrous mineral in the samples are composed mainly of chlorite with minor amounts of epidote and actinolite. Temperature dependence of isotopic fractionation factor between chlorite and water is weak both for hydrogen and oxygen, thus useful to estimate the dD values of co-existing water. The studied basalt show posittive correlation between hydrogen isotopic composition and water content. This relationship is similar to those observed in typical modern basalts hydrated at the seafloor, but systematically offsets to low dD values compared to the modern example. Based on these relationship, we have concluded that the 3.5 Ga seawater and possibly mantle were both depleted in deuterium relative to modern seawater by 24±5‰. These results may suggest that Earth's seawater would have been decreased through time due to hydrogen escape rather than increase by degassing of water from mantle inbalanced against subduction.

Tephra from Ischia: dating eruptions and geochemical changes

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Ischia is an active resurgent caldera. Volcanic activity at Ischia began prior to 150 ka, with the largest eruption being the 55 ka, caldera-forming Monte Epomeo Green Tuff (MEGT). Unravelling eruptive history from proximal deposits can be problematic due to burial, resurgent uplift and erosion. In such cases, distal tephra archives can provide valuable information about eruptive frequencies and about the long-term evolution of the volcanic-magmatic system.

Lago Grande di Monticchio (LGdM) lies 140 km east of Ischia. This anually laminated archive contains 64 Ischia tephra layers spanning 132 to 3 ka. These distal layers indicate that Ischia has experienced approximately one eruption every ca. 2100 years. We present major and trace element data for 20 of the layers and correlate 6 of these with glass data for proximal deposits.

Tephra compositions from the pre-MEGT (>55 ka: UMSA to Porticello) period comprise three compositional groups that occur repeatedly in sucessive eruptions. Tephra from smaller eruptions, e.g. UMSA and Porticello contain just one group, while larger eruptions, e.g. Tisichiello and Olummo record all three compositional groups. Proximal-distal correlations with LGdM indicate these eruptions span the 44 kyrs prior to the MEGT event.

Proximal-distal correlations indicate that the Schiappone eruption occurred 4.5 ka after MEGT. Post-MEGT tephra (<55 ka) record a step to lower FeO and TiO_2 and form compositional groups that overlap with the pre-MEGT but are displaced to lower incompatible element contents.

MEGT tephra spans a wide compositional range, broadly overlapping the three pre-MEGT conpositional groups but displaced to higher Nd and Y and containing an additional less evolved glass population. Confirmed distal equivalents of the MEGT include LGdM TM-19, Ionian Sea Y-7, and PRAD 1870 from the Adriatic Sea and probably C-18 in the Tyrrhenian Sea. Therefore, the MEGT was one of the most widely dispersed late Quaternary tephras to source from the Campanian region.

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