New developments in measuring silicon isotopes by MC-ICP-MS

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Introduction

A MC-ICP-MS (Multi Collector Inductively Plasma Mass Spectrometer from Nu Instruments) has been tested to precisely detect variations in the isotopic composition of Si on several samples.

Results and Discussion

Variation in sample $^{28}Si/^{29}Si$ ratios are expressed as $\delta^{29}Si$ units, which represent deviations in ‰ from the same ratio in a sample relative to a quartz standard measured using the bracketing "standard-sample-standard" technique. Taking into account the interferences of N_2, CO and NO in the Si mass region, and measuring in dynamic mode the Mg isotopes as internal standard, the repeatability on the $\delta^{29}Si$ measurements is better than 0.15 ‰ and its individual precision better than 0.05 ‰. Its accuracy is estimated by inter-laboratory comparison. Factors that are found to strongly affect the precision and accuracy of isotope ratio measurements by MC-ICP-MS are mass discrimination of interferences, drift of the isotope ratio and matrix effects. We will present the results obtained on natural silica and opal (quartz, diatoms, sponges) and artificial samples. We will discuss the various analytical methodologies tested (e.g., dry/wet plasma, sample dissolution, Si/Mg ratios, sensitivity).

Conclusion

These results are of great relevance regarding environmental and geological sciences where Si isotopes could open up a range of new analytical studies. Moreover, the MC-ICP-MS technique has obvious advantages over previous mass spectrometry techniques used to determine Si isotope ratios. The sample introduction system does not request handling dangerous chemicals and the instrument presents very good precision and sensitivity.

The relationship between the marine and the terrestrial (speleothems) climatic record during the last 80 ka in the Eastern Mediterranean

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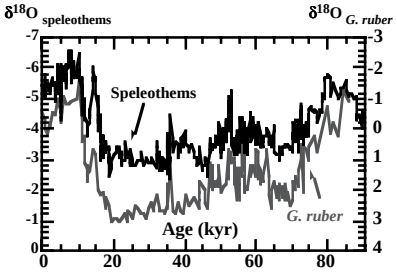
Among the key questions in paleoclimate studies is the extent of the connection between the marine and the land records. This covers issues of heat transfer, rainfall generation, and timing of climatic events. The present study explores this connection by comparing high resolution $\delta^{18}O$ records covering the last 80 kyr of planktonic foraminifera *G. ruber* from a core located off the Israeli coast, with the well-dated (U-Th) high resolution record of speleothems from the Soreq cave, located ~40 km inland.

There is a striking similarity between the two profiles (Fig. 1). The most pronounced features of the last glacial are the high amplitude $\delta^{18}O$ fluctuations during marine isotope stage 3, compared with the relatively constant and higher $\delta^{18}O$ values during marine isotope stages 4 and 2. Highest sedimentation rate and speleothem growth occurred between 34 and 36 kyr and from 52 to 57 kyr and are associated with the lowest $\delta^{18}O$ values.



Under present-day conditions the $\Delta\delta^{18}O_{G.ruber\text{-speleothems}}$ is 5.5‰ due to the fractionation between the sea surface $\delta^{18}O$ and the rainfall on-land. During interglacial sapropel events the $\Delta\delta^{18}O_{G.ruber\text{-speleothems}}$ are the lowest ~4‰, and immediately after the values increase towards present-day values. During glacial intervals when speleothems and *G. ruber* $\delta^{18}O$ have the highest values, the $\Delta\delta^{18}O_{G.ruber\text{-speleothems}}$ is the largest reaching 6.5‰. Between 60 and 45 kyr the $\Delta\delta^{18}O_{G.ruber\text{-speleothems}}$ fluctuate largely due to climate instability as reflected by the large $\delta^{18}O$ fluctuations of *G. ruber* and the speleothems. Thus, the changes in $\Delta\delta^{18}O_{G.ruber\text{-speleothems}}$ reflect the humidity differences between sea and land.