Combined silicon, oxygen isotope and trace element microanalysis of giant spicules of the deep-sea sponge *Monorhaphis chuni* for paleoclimate research

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The deep-sea sponge *Monorhaphis chuni* forms giant spicules, which can reach lengths of 3 m and diameters of 10 mm [1]. Because of the long lifespan of this sponge (several thousands years), the spicules offer a unique opportunity to record environmental change of past oceanic and climatic conditions [2]. To get a detailed time-resolved record over the lifetime of the sponge, analyses at a high resolution in the nm to µm range were performed. We investigated several giant spicules from the East and South China Sea along center-to-surface segments by determining Si isotopes with UV fs-LA-MC-ICP-MS at GFZ, and O isotopes with NanoSIMS and trace elements with LA-ICP-MS at MPI. No clear trend in Si isotope variability outside external analytical reproducibility (±0.2 ‰, 2SD) could be identified in the spicule MC from the East China Sea; average δ^{29}Si and δ^{30}Si values relative to NBS 28 were -0.67±0.21 and -1.30±0.35 (2SD), respectively. According to [3], the Si isotope fractionation is influenced by seawater Si concentration with lower isotope ratios being associated with sponges collected from waters high in Si. This implies that no significant change in Si concentration in the ambient seawater occurred during the lifetime of the sponge. Average δ^{29}Si values for the specimen SCS-3 and Q-E from the South and the East China Sea, respectively, are different: -0.43±0.22 (SCS-3) and -1.28±0.23 (Q-E) indicating different Si contents of the seawater. In contrast to these measurements, oxygen isotope data and Mg/Ca ratios of the spicule MC show a small trend in $\delta^{18}O_{VSMOW}$ from about 36±1 (rim) to 38.5±0.5 (core) and Mg/Ca from 0.062 (rim) to 0.055 (core), which can be interpreted as an increase in seawater temperature of about 3 °C during the lifespan of this specimen, similar to the results of the giant spicule QB [2].

[1] Wang et al. (2009) *Int. Rev. Cell Biol.*, 273, 69-115. [2] Jochum et al. (2012) *Chem. Geol.*, in press. [3] Wille et al. (2010) *Earth Planet. Sci. Lett.*, 292, 281-289.

Gold, Gilding and gilded marble sculpture in Antiquity: new methods, new results.

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Gilding marble statues in Antiquity was rather a common practice, as testified both by ancient literary and epigraphical sources. However, for a long time, scholars showed some reluctance to admit it, due to the lack of archaeological evidence. Today, on the contrary, new scientific methods of surveying, evidencing and analysing marble surface treatments, by combining for instance videomicroscopy and X-ray fluorescence spectroscopy, confirm without any doubt the success of gilded marble statues in ancient Greece as in Rome[1]. They also give informations about gilding an regilding processes, documenting gold leaf thickness as well as the techniques of applying it on the marble layer by layer. By crossing archeological and archeometrical evidence, it becomes then possible to reconsider both ancient taste and gilded statues functions. For instance, a bright white marble hellenistic copy of the Famous classical Greek sculptor Polycletes, found in Delos [Figure 1] at the beginning of the 20th century was originally wholly gilded [Figure 2], leading to new conclusions as regards the status and functions of such a work[2]. But at the present time, some decisive information remain unknown, as for instance the provenance of the gold itself, a central historical and economic topic for Historians and Archaologists. We need to find the missing link between antique gold mines and gilded or gold artefacts. The present talk aims also at arousing new collaborations focused on this topic.

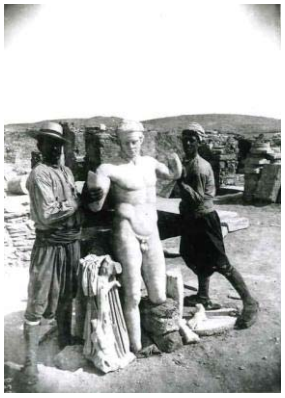

Figure 1: The so-called Polycletes's Diadoumenos at the very time of its discovery (©efa).
Figure 2: 3D digital Reconstruction of its original look (©Fauquet, Bourgeois, Jockey).

[1] Bourgeois, Jockey (2005), "La dorure des marbres grecs. Nouvelle enquête sur la sculpture hellénistique de Délos", *JdS*, juil.-déc., 253-316.
[2] Bourgeois, Jockey, Karydas (2009), "New Researches on Polychrome Hellenistic Sculptures in Delos, III: the Gilding Processes. Observations and Meanings" in Jockey (2009), *Leukos lithos. Interdisciplinary Studies on Mediterranean Ancient Marble and Stones*, 645-661.