Invasion of warm, saline, and well ventilated intermediate water in the cold stadials during the last 30,000 years? Evidence from the middle Okinawa Trough site MD01-2404

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It has been proposed that the North Pacific may play an important role on the glacial deep water formation during the cold stadials in the last glacial[1]. This deep water formation hypothesis would impact the understanding of deep ocean circulation model and the interpretation of various geochemical proxies. Less evidence, however, could be found in the intermediate water (IW) in the western North Pacific Ocean (NPO). Here we present: 1) benthic foraminiferal (*Uvigerina peregrina*, >250 μm) $\delta^{18}O^2$, Mg/Ca ratios, and calculated $\delta^{18}O_w$ from Site MD01-2404 (24°48'N, 122°30'E, water depth 1397 m) in the middle Okinawa Trough (mid-OT), and 2) composite western NPO IW ventilation ages during the last 30, 000 years.

First, IW temperatures in the mid-OT showed rapid millennial timescale oscillation from 0 to 4 °C, and $\delta^{18}O_w$ were flucutated from -0.8 to 0.3 ‰. Druing the cold stadial periods, e.g. Younger Dryas (YD), Older Dryas, Heinrich events 1 (H1) and 2, and the stadial between Dansgaard-Oeschger interstadials 4 to 5, warm and saline IW could be recognized in the mid-OT region. Second, the ventilation age from the intermediate depth (978-1397 m) in the mid-OT and the western NPO were composited to further identify this warm-saline water mass origin. The age differences could as low as 800-1000 yrs in H1 and YD periods, and as high as ~2000 yrs druing Bølling-Allerød period.

In short, this study proposed a warm, saline and relatively well ventilated IW mass intrusion to the mid-OT during the cold stadial periods through the last 30, 000 years.

[1] Okazaki *et al*. (2010) *Science* **329**, 200–204. [2] Chang *et al*. (2009) *Paleoceanography*, doi, 10.1029/2007PA001577.

Geochemical study of the stone deterioration in a granitic monument of Oporto, Northern Portugal

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The lighthouse of St Michael the Angel in the mouth of the Douro river, Porto, Portugal, has been selected for a geochemical study of the deterioration of the granite stone. The lighthouse-chapel was built in 1527, under a design by the Italian Francesco de Carmona. It has three entries, contemporary of its foundation. The dome exhibits a purity of Renaissance architecture. It constitutes a single copy in Portugal and the oldest in Europe. It is an emblematic building due to the historical features and also to the stone diseases associated to it.

The recognition of the main deterioration processes was based on the study of the representative granite facies of the Lighthouse of St. Michael the Angel. For this purpose a mineralogical and geochemical study of the granite stone deterioration and of the joint mortars, using various experimental techniques that include stereoscopic binocular microscopy, X-ray diffraction, scanning electron microscopy (SEM- EDS) and the Raman spectroscopy, was carried out. The diagnosis of the deterioration types show granular disintegration, plates, flakes, black crusts, thin black layers, biological colonization and fissuration. The geochemical study of the pathologies puts into evidence the formation of soluble salts and minerals, namely halite, gypsum, barite and calcite. The close proximity to the Atlantic Ocean in the river mouth is an important factor in the composition of rain water and in the formation of marine aerosols, with sodium chloride and sulphate ions.

The stones applied in the lighthouse were extracted from a local quarry of peraluminous two-mica granite, affected by late- to post-magmatic alteration processes well illustrated by the muscovitization of biotite and plagioclase. The potassic feldspar was strongly kaolinized. Hence, during the construction of the building, the stones already exhibited some chemical alteration inherited from the quarry, a fact that is confirmed by the presence of gibbsite and kaolinite that indicate a high degree of mineralogical evolution. The natural deterioration factors, mainly the long exposure to climate conditions and the rock susceptibility to weathering, are aggravated by the reaction of mortars with the rock minerals and by industrial and traffic pollution.