Unravelling the origin of zircon from sheared and altered ultramafic rocks of the Cycladic blueschist belt: A record of fluid infiltration?

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The eclogite- to epidote bluechist-facies sequences of the Cycladic blueschist belt in the Aegean Sea include mélanges with meta-igneous blocks and tectonic slabs (< 1 meter to several hundred meters) that are enclosed in an ultramafic or metasedimentary matrix. Due to its lithological variability, high block abundance and eye-catching metasomatic reaction zones at contacts between blocks and an ultramafic matrix, the HP mélange on the island of Syros has attracted much attention, but less spectacular and less studied block-matrix associations are widespread on a regional scale (e.g. Tinos, Andros, Evvia, Samos). Ultramafic rocks have not been reported from all occurrences and the importance of serpentinite as matrix-forming rock is highly variable, both within and between individual outcrops. Many blocks are only surrounded by a rather thin envelope of serpentinitic material or talc, -chlorite- and actinolite-rich schists which formed by shearing of ultrabasic rocks that locally still are preserved as massive, largely undeformed rock bodies. The focus of our study is on these matrix rocks, which often contain considerable modal amounts of zircon, whereas non- or only weakly deformed ultramafic blocks are zircon free. The presence of zircon in the sheared and altered zones might indicate the incorporation of debris derived from mechanical disintegration of zircon-bearing rocks during deformation. Alternatively, this zircon might represent a newly grown phase that documents Zr release during HP metamorphic mineral reactions or precipitation from syn- or post-HP metamorphic aqueous fluids. In order to test these alternatives, we are studying block-matrix associations on Syros and Tinos. Microtextural criteria and zircon characteristics (morphology, internal structure, trace element patterns, ionprobe U-Pb ages) will be used to constrain the origin and geological significance of zircon occurring in ultramafic high-strain zones.

Methane oxidation, BIF carbonates and glaciation during the earliest Paleoproterozoic

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Diminishing methane levels have been thought to be responsible for the disappearance of mass independent fractionation in S isotopes (S-MIF) and multiple glacial evelnts during the time period between 2.43 and 2.32 Ga (Zhanle *et al*., 2006). The earliest of the three glacial events is preceded by deposition of largest banded iron formations (BIFs) at a very rapid rate (> 30 m/Ma) (Barley *et al*., 1997) and a mafic magmatic event as is evident from the Hamersley Group and the Transvaal Supergroup. In other sequences where such large BIF litho-units were absent, the earliest glacial deposits seem to overlie the unconfirmity represented by quartz pebble conglomoretes and paleosols as in the Huronian Supergroup. Thus it appears that the BIF deposition at a very rapid rate has a causal effect on the initiation of the first of global scale multiple glaciation events and also the disappearance of S-MIF. Here we propose that the ^{13}C depleted carbon isotope compositions associated with various BIF lithofacies in both the Hamersley and Transvaal basins have been resulted due to oxidation of methane. The $\delta^{13}C$ compositions of carbonate and organic carbon of the various lithofacies of BIFs in both Hamersley and Transvaal basins is given in the following table and also of the source carbon assuming normal organic carbon burial:

Lithofacies	$\delta^{13}C_{carb}$ ‰ V-PDB	$\delta^{13}C_{org}$ ‰ V-PDB	$\delta^{13}C_{in}$ ‰ V-PDB
Oxide facies	-12	-18.6	-13.3
Siderite facies	-7.4	-37.8	-13.5
Carbonate facies	-1.3	-43	-9.6
Clastic facies	-3.5	-36.6	-10.1

Considering that highly deplted $\delta^{13}C$ values are resulted under normal burial conditions of organic carbon, i.e., 20% total input carbon being stored in organic form, the $\delta^{13}C$ of the input carbon during the BIF depositons would range from -13 to -8 ‰. Our calculations suggest that the ambient seawater inorganic carbon pool exchanged with CO_2 formed due to oxidation of atmospheric methane ($\delta^{13}C$ of -47 ‰) in proportions of ~ 15 to 30 %. This would amount to ~ 10^{17} moles of atmospheric methane drawdown.

Reference

Barley, M.E. *et al*. (1997) *Nature* **385,** 55-58.
Zahnle, K *et al*. (2006) *Geobiology* **4,** 271-283.