Biominerals, proxies, vital effects, and ocean palaeochemistry

H. ELDERFIELD

The Godwin Laboratory for Palaeoclimate Research, Department of Earth Sciences, University of Cambridge, Downing Street, Cambridge CB2 3EQ, UK, (he101@esc.cam.ac.uk)

Successful reconstruction of the physics, chemistry and biology of past oceans from marine biominerals requires the fusion of several strands: understanding the physical basis of trace element and isotopic incorporation, modelling, empirical calibrations, analysis of natural systems, critical evaluation of the PCF, evidence by application, high resolution records, new developments. Focussing chiefly on O, C, Mg and B of planktonic and benthic foraminifera, recent work will be presented that gives insights into the biomineralisation process (vital effects), how conflicting results from proxies may be reconciled, and on changes in ocean temperature, carbonate ion saturation and hydrography over glacial-interglacial periods.

High-pressure mineral inventory in the Ries crater, Germany: A window to phase transformation processes in planetary interiors

A. EL GORESY[1], PH. GILLET[2] AND L. D. DUBROVINSKY[3]

[1]Bayerisches Geoinstitut, Universität Bayreuth, 95447 Bayreuth, Germany (ahmed.elgoresy@uni-baureuth.de)
[2]Ecole Normale Supérieur de Lyon, 69007 Lyon, France (directeur@ens-lyon.fr)
[3]Bayerisches Geoinstitut, Universität Bayreuth, 95447 Bayreuth, Germany (leonid.dubrovinsky@uni-bayreuth.de)

High-pressure mineral inventory

The impact event that created the Ries crater in the Swabian Alb 14.7 My ago induced high-pressure phase transformations in minerals in the crystalline basement. These inversions include quartz to coesite and stishovite, graphite to diamond (El Goresy *et al*, 2001a), rutile to two new dense and ultradense polymorphs of TiO_2 (El Goresy *et al*., 2001b; El Goresy *et al*., 2001c). In situ study of these high-pressure polymorphs is a key method in uncovering critical parameters that promoted and controlled the high-pressure mechanisms of phase transisions, possible back transformations and in conducting a more realistic estimate of the equilibrium shock pressures in natural events.

Results and discussion

We successfully *in situ* localized quartz-coesite, graphite-diamond, and rutile to orthohrhombic (space group *Pbcn*) and to the monoclinic polymorphs (space group $P2_1/c$) inversions. Quartz-coesite inversion is preferably localized at the grain boundaries to neighboring denser minerals. Raman mapping revealed the presence of coesite intergrown only with undeformed quartz thus indicating partial back inversion of coesite or plausibly complete back inversion of stishovite to quartz. Graphite/diamond inversion is never complete (<60%) and is localized exclusively at the graphite/garnet interface as a result of the high difference in shock impedence. The petrographic settings of the two new TiO_2 dense and ultradense polymorphs with their parental rutile also indicate the crucial importance of phase boundary settings in accomplishing the phase transitions. Grahite/diamond and rutile to the both dense orthorhombic and the ultradense monoclinic polymorphs are encountered in graphite-bearing garnet-cordierite-sillimanite gneisses and their coexistance allows to constrain the equilibrium shock pressures to be difintely < 28 GPa and the post-shock temperature < 200º C.

References

El Goresy A. *et al*. (2001a) *Am. Mineral*., **86**, 611-621.
El Goresy A. *et al*. (2001b) *EPSL*, **182**, 485-495.
El Goresy A. *et al*. (2001c) *Science*, **293**, 1467-1470.