Laboratory shock-synthesized diamond vs. carbons from a differentiated meteorite

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Ureilites are enigmatic differentiated meteorites (achondrites) which are unusually carbon rich (up to 6 wt % of a rather paradoxal association of diamond, lonsdaleite, graphite and disordered carbons). Important questions concerning their differentiation history are: (i) the source of thermal energy, (ii) the respective origin and further evolution of each carbon component and (iii) how to reconcile a high temperature silicate partial melting event with the presence of carbon, usually oxidized. Shocks are commonly invoked [1] but a late accretion of condensed diamonds [2, 3] in a partially melted parent body has also been proposed.

Here, for the first time, carbon phases nanoscale crystallographic relationships in an ureilite (NWA4742) are investigated by High Resolution Transmission Electron Microscopy (HRTEM). Ureilite carbons is then compared with laboratory shocked graphite partially transformed into diamond.

The experimental samples (40 GPa, shock loading experiments, [3]) contain distortered graphite grains and nanodiamonds. The latter are coated with disordered carbon, interpreted as a back-transformation (annealing) of the newly synthesized nanodiamonds.

Similar observations were evidenced in NWA 4742 carbon component. HRTEM shows disordered carbon coating on nanodiamonds (~ 40 nm), with nanoscale relations strinkingly similar to laboratory shocked samples. Furthermore, some of the distortered graphite particles contain diamond inclusions. The latter show remarkable parallel contacts between their 111 planes and the 002 graphitic ones. This is typical of martensitic transformation (no atomic diffusion) of graphite into diamond during shock processes. Those associations in ureilite may then result from short time scale shocks. The required shock pressure (> 30 Gpa) is compatible with silicate partial melting and quick cooling may prevent carbon from complete oxydation.

[1] Lipschultz M. E. (1964) *Science* **143**, 1431–1434. [2] Raï *et al.* (2003) *GCA* **67**, 2213–2237. [3] Matsuda *et al.* (1995) *GCA* **59**, 4939–4949.

Envisioning the future of geochemical databases

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Geochemical data are essential for answering many fundamental questions about the age, composition, structure, & evolution of the Earth, its oceans, continents, and climate. The increasingly complex, multidisciplinary, and large-scale problems confronted by the Geoscience community demand easy access to these geochemical data by a vast number and variety of geoscientists, and their integration with a wide array of other Earth parameters. Geochemical data have long been accessible only through the scientific literature and theses where they have been widely dispersed, making it difficult for the broad Geoscience community to find, access and efficiently use the full range of available data. Online geochemical data systems such as PetDB or EarthChem now provide easy access to large relational databases that compile and integrate geochemical data from the entire literature, from theses and unpublished studies into consistent and well-documented data sets. These data systems have successfully demonstrated the benefits and impact of large digital data collections in Geochemistry. PetDB alone is cited in more than 185 publications, is used by many non-geochemists, and substantially applied in teaching.

Nevertheless, broad and open access to geochemical data is still severely impeded by the limited scope of the currently available data collections, their unlinked nature, lack of consistent standards for data formats, and by present-day practices of data publication such as missing contextual information describing the processes of data gathering and lack of unique sample identification that make the development and maintenance of digital data collections time-consuming and inefficient.

This presentation will highlight the main challenges and ongoing and evolving efforts to overcome cultural and structural barriers to open data sharing in geochemistry, both on a national and international scale. These efforts range from design approaches for geochemical data systems and definition of data standards, to initiatives to establish community-wide best practices and policies for data publication engaging professional societies and editors and publishers of scientific journals, to the advancement of international agreement on the requirements and approaches to global data exchange.