Hydrologic variability in coastal southwest USA

SARAH J FEAKINS*[1], MATTHEW E. KIRBY[2], MONG SIN WU[1] AND LINDA HEUSSER[3]

[1]University of Southern California, Los Angeles, CA 90089, USA (*correspondence: feakins@usc.edu)
[2]California State University, Fullerton, Department of Geological Sciences, Fullerton, CA 92834 USA
[3]Lamont Doherty Earth Observatory, Columbia University, NY 10964. USA.

Understanding hydroclimate variability is a pressing need in the world's drylands, yet it is here that climate projections differ in the sign and magnitude of change in precipitation [1]. Within the southwest USA a different precipitation regime influences the California coast (winter only) and the interior (bimodal winter and summer). Here, we present multi-proxy reconstructions of the hydroclimate of the coastal zone. Sediments from Zaca Lake capture a sub-decadal history of wet-dry oscillations spanning 3ka whereas Lake Elsinore records climatic transitions from 33ka to Holocene.

Hydrogen isotopes in plant leaf waxes provide a record of the changing hydrological regime. Over the last 3ka, δD values of the C_{28} *n*-alkanoic acid are highly variable across −175‰ to −125‰ in Zaca Lake. Grain size records multi-decadal variations in runoff and charcoal reveals the variable history of fire. At Lake Elsinore, a longer term shift from δD values of −190‰ at 19ka, to −120‰ at 9ka, is attributed to a shift from North Pacific to sub-tropical Pacific moisture sources, paralleling the radiative forcing trend out of the last glacial. Similarly, grain size records a long-term decrease in runoff and pollen record a transition from *Pinus* to *Quercus* indicating warming and drying. Southwest climate differs during the Younger Dryas; wet conditions found inland are linked to AMOC forcing [2]; here we show the coast remains dry.

[1] Solomon *et al*., (2009) PNAS, **106**, 1704-1709. [2] Clark *et al*., (2012) PNAS, **109**, E1134-1142.

Diamond dissolution in COH fluids

Y. FEDORTCHOUK

Dalhousie University, Halifax, B3H4R2, Canada (correspondence: yana@dal.ca)

Morphology of surface features on natural kimberlite-borne diamonds indicates their interaction with fluid and greatly depends on the composition of this diamond-destructing fluid. H_2O:CO_2 ratio in the fluid dictates the degree of rounding, intensity of the pit development on {111} face, orientation and morphology of trigonal pits, and presence of other less common etch features (e.g. circular pits, hexagons). A number of different mechanisms have being proposed to explain the diversity of diamond resorption features. Application of experimental findings to natural diamonds demonstrated a relationship between diamond morphology and behavior of volatiles in kimberlite magma. However, absence of a model that relates diamond micro-morphology to the characteristics of the reacting fluid precludes more quantitative characterization of kimberlite volatile system using diamond micro-morphology. Toward this end, we conducted atomic force microscopy (AFM) study of diamond crystals from dissolution experiments with H_2O and CO_2-fluid and from natural kimberlites.

Diamond octahedra were etched in H_2O or CO_2 fluid at 1 GPa and temperature (T) = 1150-1350ºC. AFM data collected in tapping and contact mode demonstrated that outside of few large etch pits (up to 2 um depth) the roughness of the diamond surface is less than 400 nm in H_2O fluid and increases with T. In CO_2 fluid the roughness is between 600nm and 2 um and is independent on T. Trigonal etch pits in H_2O fluid have constant diameter independent on the depth but increasing with T. In CO_2 runs trigonal pits show continuos sizes and positive correlation between the diameter and the depth. In H_2O fluid trigons are mostly flat-bottomed, whereas in CO_2 fluid they develop round bottom at higher T and more pointy-bottom at lower T. The general resorption morphology and presence of hexagonal pits in CO_2-bearing runs could be a result of the different dissolution rate in [111], [100], and [110] direction in fluids with various H_2O:CO_2 ratio. However, the more regular layer-by-layer resorption in H_2O fluid and irregular deeper material removal in CO_2 fluid may also indicate different mechanism of interaction of surface complexes formed in CO_2- and H_2O-dominated media and different rate of removal of 3- and 2-bonded atoms from diamond surface by these complexes. We conducted AFM measurments of trigonal pits on 22 micro-diamonds from four Canadian kimberlite pipes, which different geology indicates different behavior of volatiles. We use this data to examine magmatic fluid and the relative crystallization T.

www.minersoc.org
DOI:10.1180/minmag.2013.077.5.6