Thermochronological insight into the evolution of an everted Cretaceous basin: The Klamath Mountains of western North America

GEOFFREY E. BATT

John de Laeter Centre of Mass Spectrometry, the University of Western Australia, Perth, WA 6009, Australia
(gbatt@cyllene.uwa.edu.au)

Scattered inliers of Lower Cretaceous Hornbrook Formation sediments across the western Klamath Mountains of northern California and southern Oregon record the development and fill of a substantial basin during rifting of this region from the formerly contiguous Sierra Nevada block. Although capped by a profound unconformity, the truncated strata locally reach up to 815 m thick around the type locality at Hornbrook, and 1405 m in the Shasta Valley area. The formation has been argued to have originally extended much farther to the north and southeast, potentially connecting with lithologically similar strata in the Great Valley sequence and southwestern Oregon, but the fragmented distribution of the sediments has previously prevented testing of such model architectures.

Thermochronological investigation of a reconnaissance suite of samples, incorporating vitrinite reflectance measurements, apatite and zircon fission track analysis, and ^{4o}Ar-^{39}Ar dating of K-feldspar, provides new constraint of the structural development and subsequent inversion of this basin, through the proxy record provided by the thermal history of basin sediments and underlying basement rocks. This insight demonstrates that the original thickness of the Hornbrook Formation may have exceeded 5km, and offers new control of the temporal development of the basin system. Spatial variation in the thermochronological signatures identified has further allowed the phrasing of new hypotheses regarding the geographical extent of this basin and the structural controls on its development, opening the way for significant new investigations of this geologically important region of western North America.

Distribution of mineral precipitates at Arctic saline perennial springs and implications for Mars

M. BATTLER*, G.R. OSINSKI AND N. BANERJEE

Department of Earth Sciences, University of Western Ontario, London, ON, Canada N6A 5B7
(*correspondence: mbattle@uwo.ca)

Introduction

Axel Heiberg Island, Canada, is host to non volcanic perennial springs that flow through thick permafrost in areas of gypsum-anhydrite diapiric uplift [1]. Microbes thrive in spring waters [2] and may contribute to mineral crust deposition. Three spring sites were studied including Gypsum Hill (GH), with ~40 small pools and seeps on a shallow slope, Colour Peak (CP), with ~20 pipes and seeps on steep slopes, and Lost Hammer (LH), with a single 3 m vent.

Precipitate mineralogy

Bulk X-ray diffraction was performed on mineral crusts to produce surface mineralogy maps. Halite forms extensive hard white crusts at all sites. Elemental sulfur and gypsum occur together along flow edges of most springs, are likely formed by evaporative fractionation, and may be associated with sulfur-metabolizing microbes [2]. At GH, gypsum is concentrated by icing processes [1] and covers the site in fine white powder. Elemental sulfur is associated with sulfur oxidizing bacteria in 'streamer' biofilms [3]. Gypsum and quartz also occur as crystals in large mounds, which may be remnants of older springs. At CP, calcite precipitates part way downslope due to CO_2 degassing, and forms rimstone pools and travertine channels [4]. Quartz occurs more frequently at CP than previously reported, likely from sediment accumulation. At LH, significant thenardite (Na_2SO_4) and minor mirabilite ($Na_2SO_4 \bullet 10H_2O$), previously reported as gypsum, occur in softer crusts at the vent and along flow.

Analogue for Mars evaporite deposition

Salt deposits [5] and geomorphologic data [6] indicate past upwelling and evaporation of saline water on Mars' surface, perhaps by spring systems. Analogous systems on Earth may reveal how mineralization and biosignature preservation may have occured in similar springs on Mars.

[1] Pollard *et al.* (1999) *Can. J. Earth Sci.* **36**, 105–120. [2] Perreault *et al.* (2007) *Appl. Environ. Microbiol.* **73**, 1532–1543. [3] Clarke *et al.* (2009) *Microsc. Microanal* 1–13. [4] Omelon *et al.* (2001) *Geochim. et Cosmochim. Acta* 65, 1429–1437. [5] Squyres *et al.* (2004) *Science* **306**, 1709–1714. [6] Allen & Oehler (2008) *Astrobiology* **8**, 1093–1112.