Carbonatites and Large Igneous Provinces (LIPs)

R.E. ERNST

Ernst Geosciences (& Carleton University) 43 Margrave Ave., Ottawa, K1T 3Y2 Canada (Richard.Ernst@ErnstGeosciences.com)

There is increasing evidence that many carbonatites are linked both spatially and temporally with large igneous provinces (LIPs), i.e. high volume, short duration, intraplate-type, magmatic events consisting mainly of flood basalts and their plumbing systems. Examples of LIP-carbonatite associations include: i). the 66 Ma Deccan flood basalt province associated with the Amba Dongar, Bhuj, Barmer, and Mundwara carbonatites and alkali rocks, ii). the 130 Ma Paraná-Etendeka (e.g. Jacupiranga, Messum); iii). the 250 Ma Siberian LIP that includes a major alkaline province, Maimecha-Kotui. iv). the ca. 370 Ma Kola Alkaline Province coeval with basaltic magmatism widespread in parts of the East European craton. In the Superior craton, Canada, a number of carbonatites are associated with the 1114-1085 Ma Keweenawan LIP and some are coeval with the circum-Superior 1880 Ma mafic-ultramafic magmatism. In addition, the Phalaborwa carbonatite is associated with the 2055 Ma Bushveld event of the Kaapvaal craton. The frequency of this LIP-carbonatite association suggests that LIPs and carbonatites might be considered as different evolutionary 'pathways' in a single magmatic process/system. Some benefits of considering LIPs and carbonatites together are as follows: 1) mapping lithospheric thicknesses: carbonatites are from areas of thick lithosphere, voluminous basaltic magmatism from shallower depths; 2) recognizing trans-lithospheric breaks: carbonatites are emplaced along structural zones, especially large scale faults and rifts; .e.g. carbonatites related to both the 1107 Ma Keweenawan and 1880 Ma Circum-Superior LIPs are emplaced along the Kapuskasing Structural Zone, a significant break across the narrow 'waist' of the Superior craton; 3) timing of magmatic activity: carbonatites often occur early relative to emplacement of flood basalts consistent with the generation of low-degree melts ahead of major melting of the plume to produce basalts/picrites; 4) recognizing plumes: isotopic signatures for carbonatites include the components FOZO, HIMU, EM1 but not DM. This, along with primitive noble gas signatures in some carbonatites, suggests a deep mantle source for carbonatites, consistent with a plume origin proposed for many LIPs.

Holocene decadal to millennial variability of winter climate in the Pacific Northwest

VASILE ERSEK[1]* PETER U. CLARK[1] ALAN C. MIX[2], HAI CHENG[3] AND LAWRENCE R. EDWARDS[2]

[1]Department of Geosciences, Oregon State University, Corvallis, OR 97331 USA (*correspondence: ersekv@geo.oregonstate.edu) (clarkp@geo.oregonstate.edu)

[2]College of Oceanic and Atmospheric Sciences, Oregon State University, Corvallis, OR 97331 USA (mix@coas.oregonstate.edu)

[3]Department of Geology and Geophysics, University of Minnesotta, Minneapolis MN 55455 USA (cheng021@umn.edu, edwar001@umn.edu)

We present a well-dated, high-resolution stalagmite stable isotope record from Oregon Caves National Monument in SW Oregon (42°N, 123°W). $\delta^{18}O$ values of rainwater collected over a three year period at the cave site shows a good correlation with temperature with an average value of 0.6‰ $°C^{-1}$ and as a result we interpret the speleothem $\delta^{18}O$ as reflecting mainly temperature changes. Because of precipitation seasonality in south-western Oregon (wet winters and dry summers) and the rapid transit time of meteoric water through the karst aquifer, our speleothem record reflects mostly changes in cool season climate. Speleothem $\delta^{18}O$ values show an increasing trend for the last 9000 years which is in agreement with marine paleoproxies in the eastern Pacific Ocean showing increasing sea surface temperatures over the same period. The wavelet analysis of the speleothem data shows a persistent cycle throughout the Holocene with a period of ~2000 years, as well as more intermittent cycles with periods of ~500 years and 90-50 years. We compare our record with other proxies in western North America and discuss possible processes and mechanisms responsible for Holocene climate variability in western North America.