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The timing, two-pulsed nature, and variable climatic expression of the 4.2 ka event: A review and new high-resolution stalagmite data from Namibia

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ABSTRACT

The climatic event between 4.2 and 3.9 ka BP known as the "4.2 ka event" is commonly considered to be a synchronous global drought that happened as one pulse. However, careful comparison of records from around the world shows that synchrony is possible only if the published chronologies of the various records are shifted to the extent allowed by the uncertainties of their age data, that several records suggest a two-pulsed event, and that some records suggest a wet rather than dry event. The radiometric ages constraining those records have uncertainties of several decades if not hundreds of years, and in some records the event is represented by only one or two analyses. This paper reports a new record from Stalagmite DP1 from northeastern Namibia in which high $^{230}Th/^{232}Th$ activity ratios allow small age uncertainties ranging between only 10–28 years, and the event is documented by more than 35 isotopic analyses and by petrographic observation of a surface of dissolution. The ages from Stalagmite DP1 combine with results from 11 other records from around the world to suggest an event centered at about 4.07 ka BP with bracketing ages of 4.15 to 3.93 ka BP. The isotopic and petrographic results suggest a two-pulsed wet event in northeastern Namibia, which is in the Southern Hemisphere's summer rainfall zone where more rain presumably fell with southward migration of the Inter-Tropical Convergence Zone as the result of cooling in the Northern Hemisphere. Comparison with other records from outside the region of dryness from the Mediterranean to eastern Asia suggests that multiple climatic zones similarly moved southward during the event, in some cases bringing wetter conditions that contradict the notion of global drought.

1. Introduction

Evidence of a climatic anomaly that is known most widely as the "4.2 ka event" has been observed in materials including marine sediments (e.g., Cullen et al., 2000; Arz et al., 2006), lake sediments (e.g., Ohlendorf et al., 2014; Nakamura et al., 2016), glacial ice (e.g., Thompson et al., 2002; Menounos et al., 2008) and stalagmites (e.g., Bar-Matthews et al., 1999; Berkelhammer et al., 2012) that come from both the Northern and Southern Hemispheres (e.g., Drysdale et al., 2006; Ohlendorf et al., 2014) and from both the Eastern and Western Hemispheres (e.g., Berkelhammer et al., 2012; Booth et al., 2005) (Fig. 1). In fact, evidence of the event is so widespread that it has been termed a "global megadrought" (Weiss, 2016), and it has

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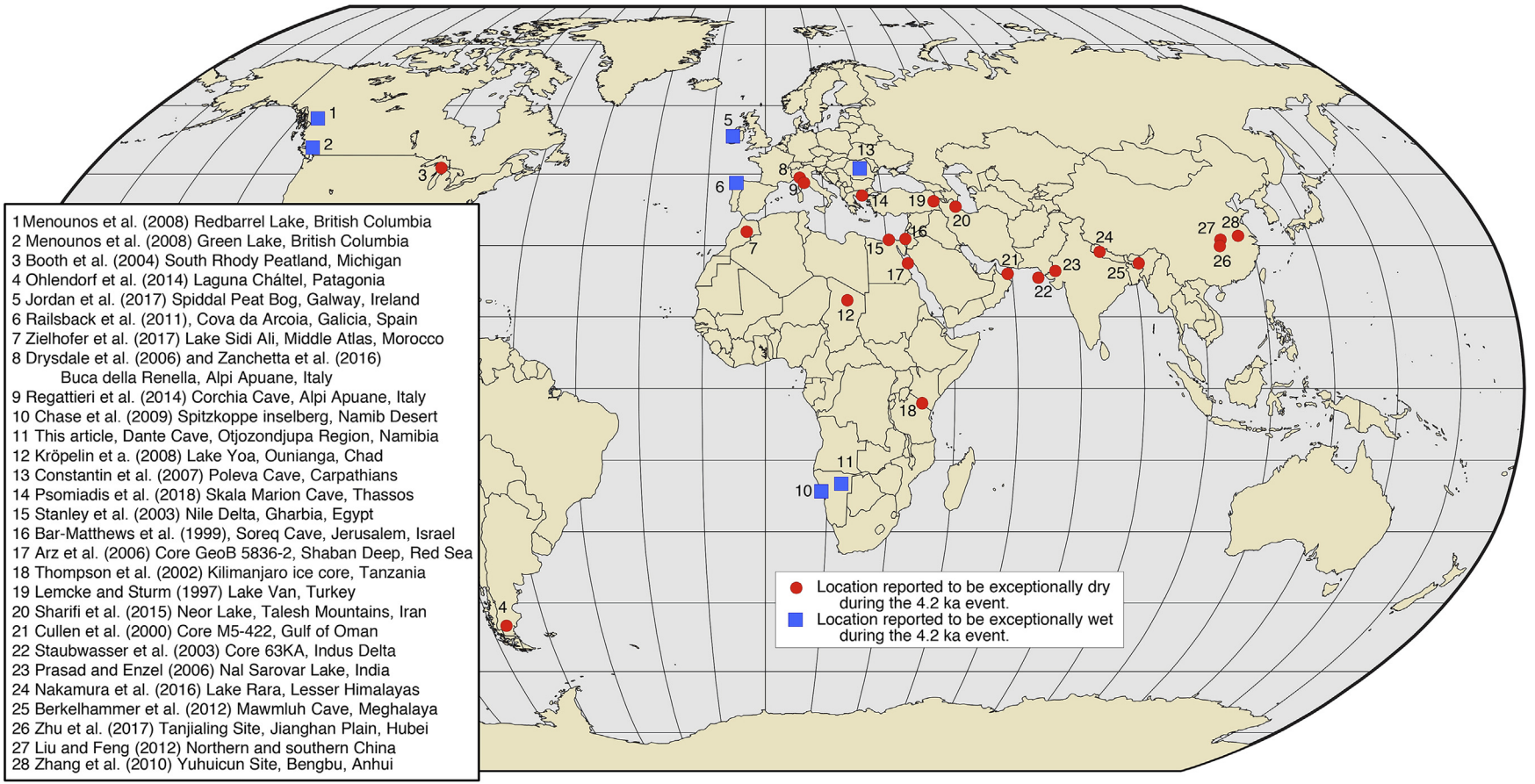

Fig. 1. World map showing some locations discussed in the text. The underlying base map is a Robinson projection from the Cartographic Research Lab of the University of Alabama.