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Ontong Java volcanism initiated long-term climate warming that caused substantial changes in terrestrial vegetation several tens of thousand years before the onset of OAE1a (Early Aptian, Cretaceous)

Christina E. Keller (1), Peter A. Hochuli (1,2), Martino Giorgioni (1), Therese I. Garcia (1), Stefano M. Bernasconi (1), and Helmut Weissert (1)

(1) Geological Institute, ETH Zurich, Department of Earth Sciences, Sonneggstr. 5, 8092 Zürich, Switzerland (christina.keller@erdw.ethz.ch), (2) Palaeontological Institute, University of Zurich, Karl Schmid-Strasse 4, 8006 Zürich, Switzerland

During Cretaceous times, several intense volcanic episodes are proposed as trigger for episodic climate warming, for changes in marine circulation patterns and for elevated marine productivity, which resulted in the widespread black shale deposits of the Oceanic Anoxic Events (OAE). In the sediments underlying the early Aptian OAE1a black shales, a prominent negative carbon isotope excursion is recorded. Its origin had long been controversial (e.g. Arthur, 2000; Jahren et al., 2001) before recent studies attributed it to the Ontong Java volcanism (Méhay et al., 2009; Tejada et al., 2009). Volcanic outgassing results in an increased pCO_2 and should lead to a rise in global temperatures. We therefore investigated if the volcanically-induced increase in pCO_2 at the onset of OAE1a in the early Aptian led to a temperature rise that was sufficient to affect terrestrial vegetation assemblages.

In order to analyse changes in terrestrial palynomorph assemblages, we examined 15 samples from 12 black shale horizons throughout the early Aptian negative C-isotope spike interval of the Pusiano section (Maiolica Formation; N-Italy). These sediments were deposited at the southern continental margin of the alpine Tethys Ocean and have been bio- and magnetostratigraphically dated by Channell et al. (1995). In order to obtain a continuous palynological record of the negative C-isotope spike interval and the base of OAE1a, we combined this pre-OAE1a interval of Pusiano with the OAE1a interval of the nearby Cismon section (Hochuli et al., 1999).

The sporomorph assemblages at the base of this composite succession feature abundant bisaccate pollen, which reflects a warm-temperate climate. Rather arid conditions are inferred from low trilete spore percentages. Several tens of thousand years before the onset of OAE1a, C-isotope values started to decrease. Some thousand years later, bisaccate pollen began to decrease, whereas an increase of Classopollis spp. and Araucariacites spp. percentages indicate a rise in temperatures. Maximum temperatures (suggested by a dominance of Classopollis spp.) were only reached after the most negative inorganic C-isotope values and after the onset of OAE1a. Our study shows that the volcanically-induced increase in pCO_2, which ultimately led to OAE1a caused a substantial climate warming that seriously affected terrestrial vegetation.

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