

U-Pb geochronology of the Emeishan large igneous province and the end of the Late Paleozoic Ice Age: connection between magmatism, climate, ocean chemistry, and mass extinction

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The Late Paleozoic Ice Age involved several pulses of glaciation from the early Carboniferous through mid-Permian in southern Gondwana. In eastern Australia, biostratigraphy suggested the final pulse to be c. 265 Ma. New U-Pb zircon ages from volcanic layers revise the age of latest glacial deposits to c. 255 Ma, making the late stage of the LPIA broadly synchronous with emplacement of the Emeishan large igneous province (ELIP) of China. Recent zircon U-Pb ages indicate rapid emplacement of the intrusive phase of the ELIP, from 260–257 Ma. New zircon U-Pb ages from volcanics overlying the youngest basalts indicate a short-lived effusive component, ending by 258 Ma. Emeishan volcanism has been linked with the end-Mid-Permian mass extinction, though radioisotopic ages from sedimentary units that record the extinction are limited. The ELIP is smaller than other magmatic provinces that have been associated with mass extinctions, though in terms of devolatilization reactions that can affect climate, volume is less significant than eruption rate and composition of the host rock. An important test of the impact of the ELIP on climate is the stable isotopic record of ocean sediments. Initial stable Ca isotope data from marine carbonates indicate the change in ocean chemistry in the Mid- to Late Permian was smaller than that associated with the end-Permian extinction, but suggest ocean anoxia. Efforts are ongoing to establish a robust chronology for the end-Mid-Permian extinction.