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SESSION 02LB (LIFE AND SOLAR SYSTEM)

International timescale calibration of the Late Permian – Early Triassic of Australia

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The Late Permian – Early Triassic interval of Australia contains a predominantly endemic biota. A paucity of international marine index fossils, in particular conodonts and ammonoids, has previously precluded precise correlation with standard northern hemisphere marine sequences and internationally established System and Stage Global Stratotype Sections and Points (GSSPs). The Permian-Triassic boundary and other Late Permian and Early Triassic stage boundary levels, and the major end-Guadalupian and latest Changhsingian (end-Permian) mass extinction levels in Australia remain poorly constrained. Attempts to calibrate the Late Permian – Early Triassic of Australia using U-Pb analyses on of zircons from volcanic products using micro-beam Sensitive High Resolution Ion Microprobe (SHRIMP) techniques have resulted in controversial radio-isotopic ages with per cent-level uncertainty and accuracy that may be compromised due to the use of a standard which is now deemed unsuitable. We will present new high-precision biostratigraphic, isoptopic geochronologic (U-Pb IDTIMS ages on chemically abraded individual zircons with permil-level resolution) and chemostratigraphic data that provide important international timescale calibration points in the Late Permian – Early Triassic of Australia. We expect that through integration of U-Pb and 40Ar/39Ar geochronology with chemo- and biostratigraphy, that the time scale of the Late Permian – Early Triassic of Australia will be greatly improved and will lead to more realistic evaluation of high-latitude end-Guadalupian and end-Permian biotic crises and their aftermaths and greater understanding of climate change in Australia and globally during this economically important time period.

The mountains that triggered the Late Neoproterozoic increase in oxygen and the radiation of animals

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The concessus view is that the O_2 concentration of the Archean atmosphere was very low and that it rose to its present level of 21% in a series of steps, two of which dwarf the others in importance. The first, known as the Great Oxidation Event, occurred at ~2.4 Ga. It involved an increase in the relative abundance of O_2, which has been estimated at four orders of magnitude, and it is important because it led to the first surface weathering. The second, although less important in relative terms, involved the addition of $9x10^{17}$ kg of O_2 to the atmosphere, about ten times as much as that required to produce the Great Oxidation Event. Its importance lies in the fact that it correlates with the rise of animals in the Ediacaran and Early Cambrian periods. Although it is widely accepted that an increase in atmospheric O_2 facilitated the appearance of animals at ~575 Ma, followed by the Cambrian Explosion ~50 Myr later, the cause of this increase remains controversial. We show that the surge in the O_2 level near the Precambrian-Cambrian boundary correlates with major episodes of continent–continent collision associated with Gondwana's amalgamation, including convergence between East and West Gondwana, which produced the 8,000-km-long Transgondwanan Supermountains. The eroded roots of these mountains include the oldest lawsonite-bearing blueschists and eclogites, and ultra high-pressure metamorphic rocks. The sudden appearance of these low-thermal gradient, high-pressure metamorphic rocks implies that the Gondwanan orogenic zones were cooler and stronger than those associated with the assembly of earlier supercontinents and therefore capable of supporting higher mountains.

There is a long-linear relationship between relief and erosion rate, and a linear relationship between sedimentation rate and organic C burial. Taken together these two relationships imply a log-linear relationship between relief and C sequestration. We suggest that the Gondwanan supermountains were appreciably higher than those produced during the assembly of earlier supercontinents and that rapid erosion of these mountains released a large flux of essential nutrients, including Fe and P, into the rivers and oceans, which triggered an explosion of algae and cyanobacteria. This, in turn, produced a marked increase in the production rate of photosynthetic O_2. Rapid sedimentation during this period promoted high rates of burial of biogenic pyrite and