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Overcoming challenges in nonmarine stratigraphy using a multidisciplinary approach: an example from Mesozoic basins of eastern Australia

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Continental sedimentary strata are particularly challenging to correlate within and between basins. In fluvio-lacustrine facies significant lateral variations over short distances limit the application of classical correlation techniques on a regional scale. This is particularly the case in the extensive continental successions of eastern Australian Mesozoic basins. Strata in these basins were deposited at high latitudes (>75°S) at a time when relatively temperate conditions prevailed as indicated by major coal accumulations and a rich diversity of palynofloras. These successions are characterized by thin (<0.4m), laterally discontinuous coal beds that can rarely be correlated for more than 5km. Without regional marker beds it is difficult to correlate or even pick regional unconformities using well log signatures or core. The need for a multidisciplinary approach is therefore essential to overcome these issues.

A combination of palynology, sedimentology, and radiometric dating of zircon-bearing air-fall tuffs and volcaniclastic sandstones provides new insights on the stratigraphic framework of the Eromanga, Surat and Clarence-Moreton Basins. U-Pb ages were acquired from zircons in 30 tuff beds using the “CA (Chemical Abrasion)-TIMS” methodology. This technique gives dates for individual tuff beds to within +/- 40,000 years. Thirty U-Pb CA-TIMS zircon ages (168-149Ma) were calculated from 13 wells from the three basins. From this data set, several chronostratigraphic datums were defined for correlation across the basins. These datums are each defined within time intervals of less than 420kyr. For the first time, it is now possible to correlate these Jurassic strata with high precision over thousands of kilometers and across multiple basins. The newly constructed chronostratigraphic framework reveals inconsistencies in previous correlation of lithostratigraphic units and identification of regional unconformities. It also demonstrates the diachronous nature of the coal-bearing lithofacies across the basins.

Palynological studies reveal the presence of marginal marine dinoflagellate cysts (most notably Mooro-dinium) and acritarchs at two other intervals. Tidal indicators, including double mud drapes and lenticular bedding, are also present at these levels. These subtle indicators of marine influences may represent the landward extent of maximum flooding surfaces.

The new stratigraphic insights allow construction of revised palaeogeographic maps of the Jurassic of east-ern Australia. The maps suggest extensive fluvio-lacustrine systems draining from an eroding orogenic belt into proximal estuarine complexes. Widespread coals are present in areas between the major fluvial channel complexes.

This study emphasizes the need for an interdisciplinary approach to correlating nonmarine strata where easily identifiable marker beds are not present and where biostratigraphic zones cover long time intervals.