Evolution and expansion of resin production in the early Mesozoic: evidence from Triassic amber and the world's oldest bioinclusions from Northern and Southern Pangaea

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Amber is an exceptional medium for the preservation of ancient life. These ancient tree resins can entomb the delicate details of plant, animal, fungal, and microorganisms in three-dimensions – their animation suspended for hundreds of millions of years. Early Mesozoic fossiliferous ambers provide significant palaeontologic insights and portals into post-Permian-Triassic mass extinction terrestrial ecosystems and their biotic recovery following this major calamity in Earth's history. New discoveries in Italy and Australia record snapshots of forest life in the supercontinent of Pangaea along with information on a major shift in climate in the Late Triassic that reveal increases in rainfall, concomitant with resin production. This shift has been called the Carnian Pluvial Episode (CPE), which occurred during the early Late Triassic some 230 million years ago. Moreover, there is growing evidence that these major climatic events were Pangean-wide with new reports of Triassic amber in Tasmania, Australia, but are these deposits indicative of the timing of this inferred major event, or did it commence in pre- or post Carnian (e.g. Norian/Rhaetian), Late Triassic times? This project aims to explore unstudied or scarcely researched rock deposits in Italy and Australia, along with the potential of discovering coeval Triassic, amber-rich beds in other Pangean rocks. Importantly, the study commences from a strong base of abundant, available amber material, which awaits investigation at the University of Padova , the Monash University in Melbourne (Prof. J. Stilwell) and CNR (Dr. G. Roghi, Padova) with academics at these institutions and internationally with already strong contacts and on-going collaborations, and the scope for further amber collecting to complete the project objectives of the spectrum of bioinclusions in the amber, its botanic origin and also climatic inferences. Diverse methodologies to complete the study of the amber comprise traditional means of mechanical extraction of the amber from coal and other terrestrial rocks through the combination of using synthetic resin and paraloid glues to consolidate *in situ* droplets from hard, lithic matrix, along with pneumatic drills and other tools. Further experimentation with consolidants and different polishing techniques for examining large numbers of amber efficiently are also being explored. Advanced imaging systems, i.e. suites of diverse microscopes at the University of Padova and Monash University, including the Visionary Digital BK Lab Macro/Microphotography system and IMBL at the Australian Synchrotron, among other imaging and scanning platforms, and also chemical analyses employing ATR-FTIR, provide the state-of-the art infrastructure to study the ancient amber and provide the best chance of success to explore this globally significant climatic and biotic event in Earth's history. Whilst the study of Italian amber has had decades of scientific progression, Australian Triassic amber is a recent discovery and requires additional investigation, given that only a handful of pieces have been recovered thus far. Further recovery of amber from Fingal Valley is likely to have important implications for understanding Triassic Gondwanan biotas, and for expanding our understanding of the palaeoclimate of southern Pangaea.

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