High-Resolution Correlation and Bentonite Tephrochronology in the Campanian Western Interior Basin

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The Late Cretaceous of the North American Western Interior Basin is world-renowned for preserving a rich fossil and paleoenvironmental history during the 'zenith' of dinosaur diversity. Along with abundant volcanic ash horizons throughout the basin, it is a perfect setting to exemplify the application of state-of-the-art U-Pb dating by chemical abrasion ID-TIMS method to the stratigraphic record. The key fossil-bearing units that are examined here comprise a variety of distinct Campanian terrestrial sedimentary units deposited along the basin's western margin from Alberta to Utah.

This study aims to broaden the reach and effectiveness of high-precision geochronology through refined stratigraphic correlations using a multifaceted geochemical approach to characterising bentonite marker horizons. Geochemical characterisation of volcanic material, a process called tephrostratigraphy, is often hampered in pre-Quaternary deposits due to chemical alteration during ash devitrification. Here we present major element characterisation of the Campanian bentonites through the novel use of glass (melt) inclusions that are encased within the same volcanic zircon crystals used for geochronology, and thus are protected from alteration. Several independent geochemical signatures are employed to support fingerprinting of bentonites including trace element composition and Lu-Hf isotopic systematics. Preliminary findings have shown promise in correlating bentonites within and even between formations. Selected bentonite horizons with statistically indistinguishable mean $^{206}Pb/^{238}U$ ages that are spatially separated by >1000km have yielded geochemically distinct fingerprints, implying synchronously eruptive volcanic centres in the northern and southern parts of the basin during the late Campanian. This multifaceted approach will facilitate the construction of a high-resolution chronostratigraphic framework for the basin by relatively inexpensive and accessible means and is entirely transferable to other basins and time periods.