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Unraveling fan-climate relationships: Milankovitch cyclicity in a Miocene alluvial fan (Teruel Basin, Spain)

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The role of climate change in alluvial fan sedimentation is often evident in geomorphological studies dealing with Quaternary successions, but remains hard to assess in the pre-Quaternary stratigraphic record, for which an additional obstacle is represented by detailed chronologies difficult to established within coarse clastic systems.
The Teruel Basin (eastern Spain) is an extensional trough whose main tectonic activity spanned from late Oligocene to Pliocene times. Permanent internal drainage and a Mediterranean semi-arid climate made the basin and its sedimentary signatures highly sensitive to climate fluctuations, especially in terms of hydrological balance. Recent studies have proved orbital control on the development of facies sequences from low-energy, basinal settings in Teruel. In particular, high-resolution chronological and paleoclimatic information has been derived by orbital tuning of mudflat to ephemeral lake deposits in the Prado area (Villastar), linking basic facies rhythms to alternating, relatively humid/arid phases paced mainly by climatic precession.
Clastic lobes from a coeval alluvial fan distally interfinger with this reference section. Stratigraphic relationships show how fan sedimentation patterns were also influenced by climate cyclicity. Highest volumes of debris transfer towards the distal mudflat repeatedly coincide with relatively humid periods. Furthermore, distal to medial fan outcrops feature prominent rhythms of distinct, alternating coarse and fine clastic packages. Such a highly organized architecture, unusual in alluvial fan successions, points to the influence of a rhythmic forcing mechanism which might have been climate variability, as evidenced by the adjacent reference section. Rather than on processes of sediment transport basinwards, climate change would have acted on sediment production and availability at the source, within the fan catchment.