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Paleohydraulic investigation of the Ebro Basin: Implications for Mars

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The stratigraphy preserved in Earth's sedimentary basins offers a record of how landscapes have evolved with time. This stratigraphy provides insights into the dynamic processes that shaped the surface of the earth. Fluvial stratigraphy contains many elements that can be used to recreate past conditions in ancient river channels. Paleohydraulic reconstruction uses measurements of fluvial stratigraphy to model the conditions in the system that created them. This allows us to answer questions related to water discharge, sediment flux, and duration of fluvial activity. These are key questions when investigated in the context of Mars. Paleohydraulic models can be used as compelling analogs for similar systems on Earth as well as Mars and other rocky planets.

This study examines what the record of Oligocene-Miocene fluvial stratigraphy in northeastern Spain's Ebro Basin can tell us about water discharge and sediment flux across distributive fluvial systems at a basin scale. The Cenozoic stratigraphy of northeastern Spain's triangular shaped Ebro Basin embodies a classic example of the formation of a closed sedimentary basin. The Ebro Basin contains a number of remarkably well exposed fluvial sedimentary deposits. These deposits outcrop as distinctive laterally contiguous channel sand bodies. Clastic sediment supply in the Ebro Basin is largely governed by tectonic uplift and basin subsidence related to the Pyrenean orogen with peripheral contributions from the Catalan Coast and Iberian Ranges. We test the idea that the record of conditions in the fluvial systems should reflect the record of lacustrine chemical sediments through sediment mass conservation. In order to test this hypothesis measurements of bedform height, barform height, sediment size, and paleochannel dimensions were collected in the field. Our paleohydraulic model uses previously derived theoretical and empirical relationships to recreate the conditions in these ancient fluvial systems. These results are scaled up by accounting for drainage density and intermittency in order to address the principal question at a basin scale. Paleodischarges from the fluvial sediments are comparable to those from river chemistry calculations for the lacustrine facies.