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Paleoecological Response and Facies Evolution in Response to Extrinsic Drivers During the Pennsylvanian–Permian Transition, Paradox Basin, SE Utah

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The Late Paleozoic Ice Age (LPIA) was a dynamic period characterized by changing paleoenvironmental, paleoceanographic, and paleoclimatic conditions, and it was under such conditions that the carbonate-siliciclastic cyclothems of the Paradox Basin were deposited. Despite extensive research on the Paradox Basin, knowledge gaps and incongruent findings persist. The availability of reliable elemental data for Late Paleozoic strata of the Paradox Basin is lacking. Furthermore, no studies have evaluated paleoecological trends for the Paradox Basin, despite evidence for dramatic changes in global marine biodiversity during the LPIA, i.e. the Serpukhovian Extinction and the Carboniferous-earliest Permian Biodiversification Event (CPBE). This study investigates the relationship between extrinsic forces and paleoecological flux as it pertains to facies variability within the Paradox Basin. We investigate two localities within the Paradox Basin (southeast Utah), Honaker Trail and Raplee Anticline, to create a composite record spanning the Pennsylvanian-Permian transition. The Honaker Trail section consists of Middle to Late Pennsylvanian cyclothemic marine carbonates and interstratified terrestrial siliciclastics. The time-equivalent section at Raplee Anticline spans the Late Pennsylvanian to earliest Permian and records a transition towards terrestrially-dominated deposition.

We identify eleven carbonate facies along with intercalated terrestrial siliciclastics and paleosols that increase in abundance throughout the section, indicating a period of long-term accommodation loss from the mid-Pennsylvanian through earliest Permian. Carbonate facies within the upper portion of the section, i.e. Late Pennsylvanian to earliest Permian, are limited to shallow water deposition (< 35m). Findings from XRF elemental data display an increase in Al_2O_3 and SiO_2 accompanied by a comparable decrease in MgO and CaO throughout the mid-Pennsylvanian to earliest Permian with the highest Al_2O_3:CaO ratios occurring at the top of the section. These observations indicate a gradual increase in terrigenous input and associated turbidity throughout deposition. Preliminary paleoecological findings document an abrupt increase in faunal density and body size across the Desmoinesian-Missourian boundary, coincident with peaks in previously estimated glacial area and ice volume for the LPIA. Along with increasing faunal density and body size comes an invertebrate fauna dominated by sensitive marine taxa-

such as crinoids, brachiopods, and bryozoans. Furthermore, elemental concentrations do not record evidence of evaporitic conditions in the upper portion of the section despite the conventional understanding that restricted conditions are most pronounced nearing the end of basin fill. These observations indicate either 1) open circulation persisted even towards the end of the basin fill, 2) climatic conditions became less arid and resulted in decreased evaporitic conditions, or 3) ocean chemistry on the shallow shelf deviated from that of the restricted basin center. Our findings demonstrate that an extrabasinal factor may have allowed sensitive marine taxa to flourish despite increasing turbidity, cool temperatures, and perceived basinal restriction. Observations of a global increase in speciation during the CPBE further support an extrabasinal factor in driving invertebrate proliferation and facies evolution for the Paradox Basin. Additional stratigraphic and stable isotopic data will elucidate the nature of paleoecological shifts, facies development, and their relationship to changing extrinsic forces.