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Evaluating Controls on Sandstone Diagenesis: A Quantitative and Qualitative Study of Carboniferous Strata in the Appalachian Basin

Carboniferous quartz, lithic and feldspar-rich sandstones from different stratigraphic intervals and locations within the central Appalachian Basin were sampled from core (90 %) and outcrop (10%) to evaluate controls on sandstone diagenesis including stratigraphic position, framework grain composition and depositional environment. The compositional multivariate data set generated from point counts was reduced using Correspondence Analysis, an exploratory, non-parametric method. A priori group designations (controls) were made before the data was analyzed.

Major conclusions of this study are, first, differences in framework grain composition correlate to locations throughout the study area, indicating different source area characteristics. Second, minerals that formed early appear to be influenced by stratigraphic position. The distribution of siderite and iron-oxide/oxyhydroxide may reflect the second order paleoclimatic signature recognized throughout the Carboniferous, where siderite formed during everwet periods and iron-oxide/oxyhydroxide during semi-arid conditions, perhaps reflecting differences in redox. Third, framework grain composition controls the distribution of diagenetic alterations in the burial environment. Despite the widespread recognition of lithic grains as an important source of silica for quartz cementation, lithic arenites are deficient in authigenic quartz, yet have undergone various degrees of illitization. The quartz deficiency is attributed to compaction-related loss of primary porosity relatively early, that inhibited sufficient fluid flow to account for much higher concentrations of quartz cement in the more competent quartz arenites. Finally, no correlation can be demonstrated between depositional environment and diagenesis.