

Multidimensional Scaling Facies Mapping of Poorly Tractable, Descriptive Data: a Jurassic Morrison Formation Case Study

MERRIAM, DANIEL F., and DOVETON, JOHN H. Kansas Geological Survey, University of Kansas, Lawrence, KS 66047 USA

Many facies descriptors of subsurface formation units are discrete attributes that reflect either presence/absence or ordinal categories of abundance, position, or state. These poorly tractable, descriptive data present a challenge to their analysis by standard parametric methods. Inasmuch as geological databases are replete with these data, it is of interest to exploit them for whatever information content they may have. MultiDimensional Scaling (MDS) methods make no assumption of linearity or metric property of data dispersion such as a normal distribution and is appropriate for analyzing these data. MDS maps observation samples in an analysis space where distances represent the closest monotonic match with dissimilarities between samples estimated by metric or quasimetric methods. The results of this technique applied to geological attribute data at well locations, then can be mapped geographically and reflect facies as characterized by MDS.

The Morrison Formation (Upper Jurassic) of Kansas provides a good case-study example of MDS methods, particularly as the formation has a mixed character, is confined entirely to the subsurface of Kansas, and almost all information is restricted to simple graphic descriptions of drill cuttings. The Morrison is dominated by sandy shales, with local occurrences of sandstone, limestone, anhydrite, and chalcidony (chert). MDS analysis of observations from drill cuttings enabled facies maps to be constructed for the Morrison Formation that have features useful in stratigraphy and can be related to Kansas geological elements.