Determination of Sedimentary Palaeotransport Directions in the Subsurface: A Critical Appraisal

Lomas, Simon, Baker Hughes, Houston, TX

This contribution reviews techniques for determining paleocurrent and paleoslope orientations from borehole data, and applications to estimate reservoir body geometries at scales below the limit of seismic resolution.

Subsurface paleotransport analyses are commonplace, but the principles are too frequently misunderstood or misapplied. Nevertheless, the basic premise is straightforward: certain primary sedimentary structures provide reliable indicators of local sediment transport directions and those features are potentially identifiable, and their orientations measurable (subject to an adjustment for post-depositional tilting), in borehole image logs or oriented core. Similarly, the orientation of depositional slopes can be estimated from the axial surfaces of slump folds or dip patterns in slope collapse deposits. Additionally, detrital grain fabrics determined from oriented core plugs may further constrain paleocurrent axes.

Although the rationale is simple, there are serious caveats. We illustrate the principles, limitations and pitfalls of subsurface paleotransport analysis with case-studies utilizing high-resolution image logs. We also use outcrop case-studies to quantify geometric relationships between mesoscale sediment body architecture and smaller directional features resolvable at the wellbore scale (e.g. on an image log). Despite the inherent complexity of sedimentary systems, integration of paleotransport data with careful depositional environment analysis has proved highly successful in predicting subsurface reservoir body shape and orientation in certain settings. However, context is critical and, in isolation from a robust sedimentological interpretation, such directional data may be misleading or meaningless. Hence we advocate a rigorous integrated methodology and oppose uncritical use of dip data from image logs or diplogs as indicators of sediment body geometry.