Advanced Particle Shape Analysis in Conglomerate Reservoir From Borehole Resistivity Image

Shiduo Yang[1], Weidong Huang[2], Chaofeng Chen[2], Isabelle Le Nir[1], Junyi Yuan[1], Shenzhuan Li[3], Heike Delius[4], and Krishna Pokhriyal[4]

[1]Schlumberger, Clamart, France.
[2]Petrochina, Xinjiang, China.
[3]Schlumberger, Beijing, China.
[4]Schlumberger, London, United Kingdom.

ABSTRACT

Sedimentary particle shape analysis provides fundamental information for hydrodynamic condition and depositional environment interpretation. The spiral distribution of sediment particles provides key information on reservoir quality evaluation. The traditional grain size analysis can only be achievable from lab testing on rock samples from full-bore or sidewall cores. And it is not possible to get accurate particle size in conglomerate because of measurement limitation, only visible larger sediment particle can be identified from borehole image. The particle edge is often missed because of the low coverage of pad image tool in large bit size hole. A new developed full-bore image reconstruction technology give an opportunity to fill the pad gap and provide better visualization on heterogeneity and texture of rocks such as pebble, clasts and vugs. The particle shape and size analysis in conglomerate can be estimated more efficient from this reconstructed full-bore image. We first analyze the patches on the images corresponding to high and low measurement by Morphological Survey method on reconstructed full-bore image or high definition azimuthal full-bore images. The patches are representative of different sizes of sedimentary particles. Subsequently, the long/short axis length and size of the patches are calculated. Because of measurement limitation, the axis length from borehole image is slight different from actual length measured on core data; and the finial length is calibrated with lab measurements on core data in different image background. In addition, the roundness and sphericity of each patch are computed from geometry analysis of the image. The apparent dip of long axis of patches is used for paleocurrent direction analysis, especially there is a lack of cross bedding evidence in conglomerate formation. This new solution was applied in conglomerate formation from different depositional environments in two wells with water-based mud and oil-based mud separately: alluvia fan delta, braided river, submarine fan. All of the paleocurrent direction analysis results are consistent with seismic interpretation or crossbedding analysis of offset wells' sandstone. Moreover, the particle size distribution provides valuable information for the reservoir quality evaluation and confirmed with mud logging or production testing data.