Effect of PDC-bit platelets on geochemical data quality and hydrocarbon-systems evaluation

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Over the past two decades, technological advances in polycrystalline diamond compact (PDC) bits have led to increased drilling efficiency and prolonged bit life. As a result, PDC bits are now more widely used than traditional roller-cone bits. PDC-bits, however, alter rock textures potentially impacting geochemical data quality and hydrocarbon-systems evaluation in frontier-exploration areas.

The formation of PDC-bit platelets is one component of a spectrum of drill-bit generated artifacts, ranging from slight textural alteration to extensive drill-bit metamorphism (DBM) where partial melting and quenching result in glassy cuttings (Wenger et al. 2009). Even when DBM is not severe, drill cuttings generated by PDC-bits have an unnatural 'platelet' texture (Figure 1) that suggests the rock has been compromised. Previously, little was known about the structure and composition of PDC-bit platelets, and whether platelet formation itself alters geochemical parameters in the absence of severe DBM.

As cuttings are a primary source of geologic and geochemical information, it is critical to understand the effect of PDC-bit platelets on geochemical data quality and if parameter correction is possible. The effect on data quality was evaluated by comparison of data gathered from analysis of platelets and cores from the same depth using a sample set from several wells representing a range of lithologies and drilling conditions. Platelets were observed to form in fine-grained sediments, including shales, siltstones, evaporates, and limestones. However, within this sample set SEM and XRD analyses of shale platelets show that the 'plates' are composed of putatively unaltered sediments that retain their original elemental composition and mineralogy. All platelets are contaminated to varying degrees by drilling mud solids that partially fill the areas between the plates and this contamination offsets elemental and organic-carbon analyses between core and cuttings. TOC values from platelets are systematically shifted with respect to cores, suggesting addition of drilling mud solids. Rock-Eval measurements are also affected by organic additives in the mud, and the impact on Hydrogen Index (HI) and Oxygen Index (OI) values is significant enough that it could change source-rock quality interpretations.

Results suggest that, with sufficient information on elemental and organic composition of mud solids, it is possible to "correct" affected TOC and Rock-Eval measurements if platelets have not experienced severe DBM. Corrections have been developed to add/subtract from TOC and Rock-Eval parameters based on analyses of drilling muds for individual wells. These findings provide support for when geochemical analyses of PDC-bit platelets may provide useful information versus when they are too altered to yield meaningful data.

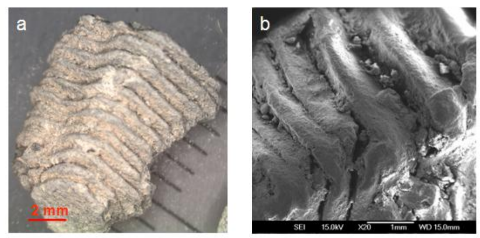

Figure 1. a) Picture of a PDC-bit platelet showing the characteristic structure generated by the shearing action of the drill-bit b) Secondary electron SEM image of a PDC bit platelet showing contamination with mud solids (predominantly barite) in-between plates.

References:

Wenger, L.M., Pottorf, R.J., Macleod, G., Otten, G., Dreyfus, S., Justwan, H., Sekula-Wood, E. 2009. Drill-bit metamorphism: Recognition and impact on show evaluation. SPE paper 125218 presented at the 2009 SPE Annual Technical Conference and Exhibition, New Orleans, LA, 4-7 Oct.