Origin of authigenic chlorite in deep marine siliciclastic turbidites and their implication on reservoir quality

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Authigenic chlorite grain-coatings are very common in siliciclastic rocks. Their presence can either improve or reduce the reservoir properties of sandstones. To date, only a few studies have focused on their origin and formation mechanisms in turbidite sandstones. Here, we discuss the origin and distribution of chlorite coatings in the turbiditic sandstones of the Agat Formation (Aptian/Albian) in the northern North Sea.
Chlorite coats exert a major control on the reservoir quality in the Agat sandstones. In the lower part of the reservoir, chlorite forms a thick coat (15-25 μm) around detrital grains that strongly reduce permeability. Conversely, in the upper part of the reservoir, chlorite coats are thinner (4-10 μm), favoring porosity preservation by inhibiting the development of quartz overgrowth. X-ray diffraction and electron microscope observations indicate Fe-rich chlorite of Ib ($\beta = 90°$) polytype suggesting a transformation from a berthierine precursor. Chlorite formation was favored by the presence of abundant Al and Fe-rich detrital grains (glauconite, ooids, and mudclast). The dissolution of these grains at low temperature under reducing conditions created a suitable environment for the growth of berthierine. This step was followed by the transformation of berthierine into chlorite at higher temperatures (>50 °C) through a solid-state transformation. The development of thick chlorite coatings in the lower part of the reservoir was mainly related to highly abundant Fe-grains, providing a significant amount of iron upon dissolution.
This study shows the important role of chlorite coatings in controlling the reservoir quality in turbidite sandstones. It also highlights the role of inherited sediment composition in controlling the abundance and thickness of the chlorite coats.

Mots-Clés : sandstone, turbidites, chlorite coating, reservoir quality

Merci de ne rien inscrire dans cette zone et ne pas modifier les marges des pieds de page et entêtes.