# Carbonate cementation of ash beds in marine source rocks: example of the Vaca Muerta Fm (Argentina)

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As many other petroleum source rocks in the world, the marine Vaca Muerta Fm (Tithonian-Valanginian, Neuquén basin, Argentina) contains numerous centimeter-thick ash beds (up to 4 per meter). These beds play an important role in the propagation of hydraulic fractures in unconventional oil/gas shale production, and may influence fluid migration during early primary oil migration. Based on mineralogical and geochemical analysis on samples from cores and outcrops (optical and SEM microscopy, µXRF mapping, Qemscan, XRD and SIMS), two main families of ash beds of calco-alkaline parentage have been recognized. The first family, the clay-rich ashes, is characterized by a matrix made of an illitized volcanic glass, with mainly albite phenocrystals locally altered into calcite. The second family, the calcite cemented ashes, is characterized by argilitized glass shards, pumice fragments and vesicle particles associated with mineral fragments, supported by a calcite matrix making 50 to 75% of the rock. Calcite-cemented ashes, which can be classified as diagenetic carbonates, commonly overlie the clay ashes, pointing to related events of volcanic ash emission but distinct diagenetic evolution. In the calcite-cemented ashes, petrographic observations clearly show that matrix carbonates precipitated early, before compaction. Accordingly, the variably negative $\partial^{13}C$ values of the calcite matrix obtained by SIMS (~0 to -20‰) could be explained by early precipitation in marine porewaters variably affected by microbial sulfate reduction. In contrast, the low $\partial^{18}O$ values (-5 to -20‰) are not expected in near-surface marine conditions, but could point to variable isotopic reequilibration during subsequent burial. Alternatively, both isotopic trends may result from isotopic exchange with the ash beds. These observations show that early marine diagenesis of argillaceous source rocks can be strongly influenced by small scale lithological variations, up to forming secondary diagenetic carbonate layers with distinct mechanical and petrophysical properties.

**Mots-Clés :** Source rocks, ash beds, diagenesis, calcite, carbonates, cementation, sulfate reduction

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