Diagenetic silicification in the presalt carbonate reservoirs of the Kwanza basin, offshore Angola: constrains from fluid inclusions, stable isotopes and U-Pb dating

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Presalt (Aptian) lacustrine carbonates occurring in the Kanwza basin, offshore Angola, represent signficant oil&gas targets. These formations have been affected by complex hydrothermal diagenesis, which profoundly modified the sediment through intense dolomitisation and silicification processes (Girard and San Miguel, 2018). Silification processes are ubiquitous in presalt carbonates offshore Africa and Brazil, but remain poorly understood in terms of origin, timing and formation conditions (Teboul et al. 2018). We report the results of a fluid inclusions, stable isotopes (O, Si) and U-Pb dating study which permits to place constrains on the conditions of silicification in the presalt carbonate (Chela formation) of the Kwanza basin. Diagenetic silica mainly occurs in the lower part of the formation and exhibits four different habits (in chronological order): radial fibrous silica, laminated chalcedony, micro-quartz and mega-quartz, which develop either as carbonate replacive, pore-filling or vein-filling cement. $\delta^{18}O$ and $\delta^{30}Si$ values are variable and elevated, ranging from 26 to 39‰ (smow) and -2.2 to 5.2 ‰ (NBS-28) respectively. There is considerable overlap among the different silica types (only chalcedony tends to show the lowest $\delta^{18}O$ values) and no distinct correlation between $\delta^{18}O$ and $\delta^{30}Si$ values. The total range in isotopic composition encompasses that of hydrothermal silica occurring as vein filling in igneous intrusions found in the underlying volcaniclastics sandstones of the Cuvo formation. Aqueous fluid inclusions found in the mega-quartz silica yielded Th values of 80-120°C and elevated salinity (17-25 wt% NaCl equivalent), and U-Pb dating of the chalcedony silica provided an age of 91.7±3 Ma (Turonian). Overall, the results suggests that the bulk of the diagenetic silicification in the presalt carbonates of the Kwanza basin is related to circulations of hydrothermal brines at moderately high termperatures during burial, some 25-30 Ma after deposition. The formation conditions of the early radial fibrous silica cement remain somewhat unclear (low T, meteoric water ?) but data are not suportive of a biogenic origin.