Silicification of lacustrine sediments in volcanic settings: constraints from Camp dels Ninots (Caldes de Malavella, NE Spain)

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Abstract: The diagenetic evolution of the opal-A to microquartz have important effects in rock petrophysics, and thus in reservoir quality. This work reports a new case study of sediment silicification from the lacustrine infill of the Camp dels Ninots maar-diatreme (La Selva Basin). Silica nodules and associated host rocks were sampled from three well cores (CC, CP1 & CA) and studied by means of X-ray diffraction, petrography, and isotopy techniques. Furthermore, the CP1 & CP2 (which rock recovery was not obtained) wells were analysed with ultrasonic acoustic borehole image techniques to characterize the geophysical signal of the studied facies. Well core and analytical data indicate that silica nodules appear in all facies although dominantly replace carbonate facies. The nodules are made of opaline silica with differentiate textural characteristics between opal-A and opal-CT specimens, denoting a diagenetic transformation from the former. The opal-A precipitated as microspheres directly from Si-rich waters likely favoured by the decrease in water pH during humid climate episodes. The opal-CT is formed as a diagenetic evolution of opal-A favoured by time and temperature and is represented by complex morphologies like botryoidal aggregates. Results indicate that the diagenetic transformation of opal-A to opal-CT is non-complete in the studied sediments, being chalcedony and microquartz silica phases totally absent. The carbonate facies are mostly made of different types of dolomite. Dol-1 precipitates directly from Mg-rich waters likely favoured by salinity concentration in lake waters during dry climate episodes. Dol-2 is formed from Dol-1 aggregates related with biological activity (methanogenesis) and shows abundant intergranular porosity, which is partially filled by dolomitic cement (Dol-C). In addition, the perfect correlation between CP1 continuous core recovery and televiewer imagery allows characterizing the silica nodule rich facies and dolomite rich facies. It also allows inferring the mineralogy and facies in a CP2 well without continuous core recovery.

Key words: maar sediments, silicification, opal-A, opal-CT, porosity