Clay-rich sediments injected into clastic dykes during earthquakes in the Galera fault zone (Guadix-Baza basin, Central Betic Cordillera)

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The Galera Fault zone is a sinistral fault, which is 23 km long and strikes N48ºE [1, 2]. The fault zone is 1.5 km wide with several parallel splays dipping NW between 40º and 60º, although vertical dips have also been noted locally.

During field observations within the area, clastic dikes were identified crosscutting the stratification of the sequence as well as filling spaces in between stratification planes. The clastic dikes are composed of medium sand size grains in a matrix of clay minerals. The mineral species identified through x-ray diffraction include quartz, albite, mica, chlorite and smectite. The SEM study reveals prismatic oriented fragments of diatoms. The muscovite and clinochlore crystals show a larger grain size than smectite which exhibits a flaky morphology and its presence is associated with the diatom fragments.

Injection clastic dikes have been previously described as a form of seismites, and their emplacement corresponds to episodic pulses of increasing hydraulic pressure generated by seismic loading [3]. Given that other co-seismic structures such as globular seismites have been identified in the area [4] and considering the clastic origin of the material we could infer that the sediments were saturated with water as a result of fluid circulation asociated with the fault zone and later injected into fractures during seismic events.

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Geochemical and microbial signals related to carbonate formation in the subsurface of Rio Tinto

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Rio Tinto is considered a good geochemical terrestrial analogue of Mars due to its high content of iron and extreme acidic pH [1]. The occurrence of carbonates in this extreme environment is very local and they are found to occur under certain conditions of pH and iron concentration [2]. To understand its formation we have recovered and generated samples from cores, taken from wells BH10 and BH11 of depths of 340 and 620 meters, respectively, under anaerobic and sterile conditions. These wells were drilled during the field campaign of the Iberian Pyrite Belt Subsurface Life (IPBSL) project. IPBSL is a drilling project, currently under development, specifically designed to characterize the subsurface ecosystems operating in the Iberian Pyrite Belt (IPB), in the area of Peña de Hierro, and responsible of the extreme acidic conditions existing in the Rio Tinto basin [3]. The present study emphasizes the mineralogical, geological-biochemical and microbial implication for carbonate formation in Rio Tinto. Herein, we show that the formation of carbonate minerals in Rio Tinto is closely related to microbial activity and that can occur under both oxic and anoxic conditions. The formation of carbonates in such extreme environment could explain the occurrence of carbonates on Mars. Finally, this environmental and experimental study provides potential mineralogical biosignatures that may be useful to test life on Mars and other extraterrestrial habitats.

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