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DOLOMITE AND SULPHATE FORMATION IN AN ARIDE ENVIRONMENT, WESTERN QAIDAM, CHINA

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The ca. 120000 km^2 large, rhomb-shaped Qaidam basin contains up 3 to 17 km thick Mesozoic to Cenozoic sedimentary sequences. It is surrounded by the Kunlun/Qimantagh, Qilian and Altyn mountain ranges and is situated at the northern edge of the Tibetan plateau. Mean surface elevation of the basin floor is ~2700 m, whereas the surrounding mountains reach elevations over 5000 m. The thick Pliocene-Quaternary sediments were controlled by tectonic processes related to uplift of the Tibetan plateau, as well as by climatic changes related to the plateau growth. The present day climate represents the driest period during the last 40 ka with mean annual precipitation of 25 mm in the centre of the basin and 100 mm along the border. Mean annual evaporation is ~3000 mm, while average temperature variations are from –10 to 20°C. The landscape is characterised by salt lakes, playas and aeolian landforms. In this study we reconstructed Pliocene and Quaternary lacustrine paleoenvironments by examining mineralogy, fabrics and geochemistry of climatic sensitive rocks, such as carbonates and sulfates from the western part of the Qaidam basin. Stable isotope analyses on carbonates from lake evaporites collected from the non-marine western Qaidam basin indicate a large positive $\delta^{18}O$ and a slight positive $\delta^{13}C$ shift between the Pliocene and the Quaternary. The large positive shift in $\delta^{18}O$ values between the Pliocene and Quaternary is interpreted as a climatic change from relatively humid conditions to cool, arid conditions. Such high aridity conditions and a closed lake environment were deduced for the Quaternary from other proxies like e.g. the widespread salt-deposits and pollen distribution. At Dafeng Shan quarry, the Quaternary sequences are composed of alternating layers of celestine/dolomite and aragonite/calcite/barite with distinct isotopic compositions. The dolomitic sequence described at Dafeng Shan formed in a low energy, hypersaline lacustrine environment as indicated by the microstructures, evaporite minerals as well as the absence of lithoclasts. The carbonate particles (peloids, ooids and oncoids) are related to microbial activity in the saline lakes. The oxygen isotopic compositions of carbonates vary between +34.4 and +39.8 ‰ (SMOW), representing the heaviest oxygen isotopic values in carbonates measured until today. The $\delta^{18}O$ and the $\delta^{34}S$ isotopic compositions of celestine range between +20.1 to +22.3 ‰ (SMOW) and +19 to +22 ‰ (CDT), respectively, suggesting sulfur recycling via sulfide oxidation. The carbon isotopic compositions of carbonates show a large negative excursion of up to –30 ‰. Microstructures, mineralogy, isotopic compositions as well as the geological context suggest oxidation of methane from a deep-seated source.