
Paleosol-induced early dolomitization constrained by U-Pb age and its implications for fluid pathways in ancient sandstone aquifers

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Résumé

In hydrogeology, a key challenge involves identifying patterns within ancient formations to forecast the distribution of fluid pathways and barriers to permeability, as well as comprehending the palaeohydrological system and its changes over time. This study addresses two main research inquiries concerning fluid flow: firstly, the influence of dolomitization induced by paleosols on flow characteristics, and secondly, the implications for fluid flow pattern distribution in continental sedimentary units. The objectives are pursued through: (1) investigation of petrographic features of diagenetic minerals and their ages using the U-Pb geochronology system; (2) meticulous, high-resolution measurements of porosity and permeability coupled with well-log data from an outcrop and two boreholes. Findings suggest that early dolomitization in continental sequences significantly affects fluid flow properties across the basin. The development of paleosols triggered early dolomitization, supported by U-Pb geochronology evidence. Subsequent groundwater migration along hydraulic gradients, influenced by fluctuations in the local aquifer’s water table, facilitated the vertical distribution of dolomitization. Dolomitization occurred in residual pores resulting from initial mineral alteration, early lithifying the sediment and preventing mechanical compaction, thus preserving porosity. During migration events, fluids moved vertically along local faults and horizontally through the dolomitized layers of the formation, which likely remained porous at the time, leading to substantial silica mineralization.

Mots-Clés: U, Pb geochronology, dolomite, paleosoils, aquifers

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