Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.36703

Differential Feldspar Dissolution in Organic-Rich Shales: Mechanisms and Control on Pore Systems for Shale Gas — A Case Study of the Qiongzhusi Formation, Sichuan Basin, China

KESU ZHONG[1,2,3], LEI CHEN[1], XUEWEN SHI[1,2,3], GUANGHUI WU[1], CHAO LUO[2,3] AND JIANHUA ZHAO[4]

[1]School of Geoscience and Technology, Southwest Petroleum University

[2]Shale gas research institute of PetroChina Southwest Oil & Gas Field Company

[3]Sichuan Provincial Key Laboratory of Shale Gas Evaluation and Exploitation

[4]China University of Petroleum (East China)

Predicting reservoir heterogeneity is a key challenge in shale gas exploration, particularly due to a poor understanding of the differential diagenetic processes controlling pore networks. While feldspar dissolution is a recognized porosity-generating mechanism, the factors governing the varying solubility of different feldspar types and the quantitative impact on reservoir quality in organic-rich shales remain poorly constrained. This study investigates the Lower Cambrian Qiongzhusi Formation shales in the Sichuan Basin using an integrated approach combining thin-section petrography, SEM-cathodoluminescence (CL), electron probe microanalysis (EPMA), and LA-ICP-MS. This methodology enabled a precise genetic classification of feldspars into 3 groups and 8 subtypes.

The results reveal significant differential solubility. Diagenetic microcline and albite, characterized by abundant crystal defects, were identified as the most soluble phases, with dissolution intensities over five times greater than stable detrital feldspars. The dissolution process occurred in two dominant stages: an early diagenetic stage (50–150°C) driven by acids from kerogen degradation, forming pores partially filled by bitumen and authigenic minerals; and a mid-to-late diagenetic stage characterized by continued dissolution fueled by CO_2 from bitumen cracking, which enhanced pore connectivity. Quantitative analysis demonstrates a positive correlation between total porosity and feldspar content. Crucially, we introduce the parameter **"Effective Feldspar Content"** (the proportion of diagenetic feldspars) as a key predictive metric. Feldspar dissolution pores constitute 30–80% of the inorganic porosity, with albite dissolution pores accounting for over 50% of this volume.

This work elucidates a critical constructive diagenetic mechanism in organic-rich shales, fundamentally driven by multi-stage organic matter evolution. The findings demonstrate that differential feldspar dissolution is a primary control on pore system heterogeneity. The proposed "Effective Feldspar Content" parameter provides a novel geochemical tool for assessing and predicting shale gas reservoir quality, with significant implications for de-risking exploration in analogous shale systems.