

Reconstruction of fluid migration events through a fractured reservoir recorded by saddle dolomite-hosted petroleum inclusions (Pannonian Basin, Hungary)



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Fig. 1. Geographic situation of the study area.

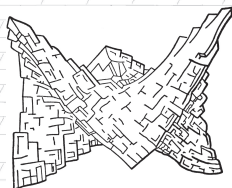


Fig. 3. Typical morphology of saddle dolomite crystals. (Davies & Smith 2006)

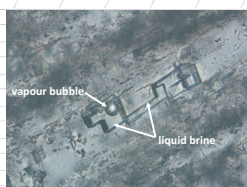


Fig. 5. Primary negative-crystal-shaped aqueous inclusion, which consist of saline aqueous liquid and small vapour bubble at room temperature.

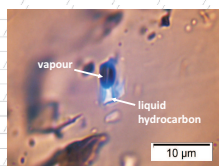


Fig. 6. Paired transmitted and UV light photomicrographs of a blue fluorescing negative-crystal-shaped hydrocarbon inclusion.

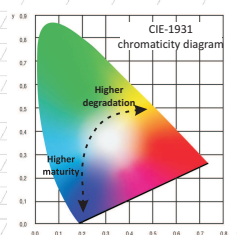


Fig. 9. The fluorescence properties of the hydrocarbon fluid inclusions display a systematic blue shift to lower wavelengths with decreasing aromatic content and/or higher thermal maturity. (Stasiuk and Snowdon 1997)

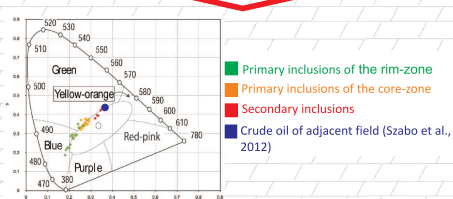


Fig. 10. UV-fluorescence colours of studied inclusions plotted in the CIE-1931 chromaticity diagram.

Introduction

The Szegedi Dolomite Formation is the most common Triassic basement formation in the southern part of the Pannonian Basin in Hungary. It is characterized by shallow marine dark grey brecciated dolomite (Fig. 2.). In this highly fractured host rock, six distinct dolomite vein generations can be distinguished based on textural relationships. One of these vein types is filled by a peculiar series of fracture-filling minerals, whose most dominant member is a saddle dolomite phase.

Saddle dolomite (Fig. 3.), which may contain hydrocarbon and metal sulfide inclusions, is a useful geothermometer, indicating minimum burial temperatures of 60 °C to 160 °C that is equivalent to the temperature of the oil window. It is often a byproduct of chemical compaction and thermochemical sulfate reduction, and it is typically related to the throughflow of high-temperature hypersaline basinal brines. (Radke and Mathis, 1980)

The aim of this study was the genetic analyses of the fluid inclusion assemblages, which trapped in saddle dolomite crystals by using fluid inclusion petrography, microthermometry and ultraviolet (UV) microspectroscopy.

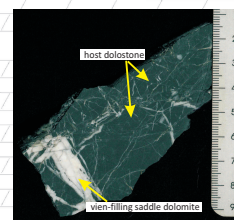


Fig. 2. The hand specimen of dark grey fine crystalline dolomite with vein-filling sparry saddle dolomite.

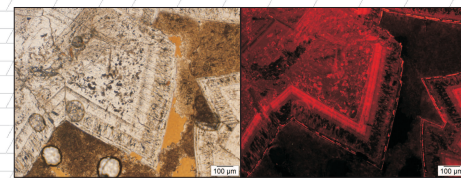


Fig. 4. Fracture-filling saddle dolomite cement with cathodoluminescent zoning showing a typical temporal succession of dull luminescence, bright luminescence and non-luminescence. That succession reflects temporal geochemical changes.

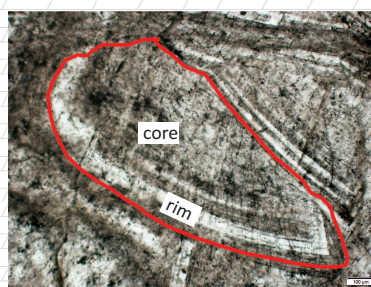


Fig. 7. Saddle dolomite crystal with cloudy core surrounded by clear rim.



Fig. 8. Sketch of the observed co-genetic hydrocarbon and aqueous inclusion generations. Any co-genetic aqueous inclusion was not found along secondary inclusion assemblage.

Results

The saddle dolomite cements appear as milky white in hand specimen, ranging from 250 µm up to 2 mm in size, completely filling the cracks and cavities of the host dolomite. They commonly exhibit curved crystal shape and display undulose extinction under cross-polarized light. The crystals show cloudy cores surrounded by clear rims (Fig. 7.). The cathodoluminescence image of crystals also shows zonation (Fig. 4.).

Petrographically, three different hydrocarbon (HC) inclusion assemblages could be distinguished (Fig. 8.).

Results of microthermometric measurements are provided in Fig. 11. and Fig. 12.. There are no significant difference between homogenization temperatures of the aqueous inclusions situated along the core and the rim. Microthermometry performed on co-genetic aqueous and hydrocarbon inclusions suggests decreasing methane saturation with time.

Comparing the fluorescence spectra of primary hydrocarbon inclusion assemblages (Fig. 10.), an early charge of relatively low maturity oil and a later charge of higher maturity oil during the precipitation of saddle dolomite crystals is presumable. The least mature inclusion oil trapped in the secondary petroleum inclusion assemblage.

The results of UV-fluorescence micro-spectroscopy confirmed that three different hydrocarbon inclusion assemblages trapped different oil types, and indicate that the crude oil produced in the field (Szabó et al., 2012) is more similar to the oil trapped in the later formed (Secondary), fluid inclusion assemblage.

In summary, complex petrography of the saddle dolomites and chemical difference between fluid inclusion assemblages suggests changes during the precipitation of dolomite crystals.

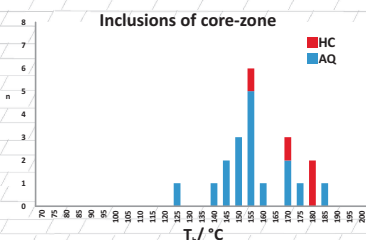


Fig. 11. Homogenization temperatures of the earlier co-genetic aqueous and hydrocarbon inclusions.

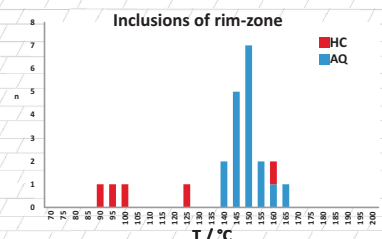


Fig. 12. Homogenization temperatures of the subsequent co-genetic aqueous and hydrocarbon inclusions.

Acknowledgements

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