



Petrography and diagenesis of cavity-fill dolocretes, Kuwait



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ABSTRACT

Cavity-fill dolocretes within the palaeokarst zone of the Middle Eocene chertified dolomicrite Dammam Formation are exposed within a quarry located on the top of Al-Ahmadi ridge in southern Kuwait. They are characterised by the abundance of zoned and spherulitic dolomite. These dolocretes are formed by massive precipitation of primary dolomite into cavity-fill siliciclastics within phreatic groundwater conditions during arid to semi-arid period. Successive stages of karstification and dolocretisation are responsible for the development of two types of cavity-fill dolocretes, namely; mature and immature dolocretes. The association of diagenetic alunites with the cavity-fill dolocretes suggests that hydrocarbon seepage may have played a role in the development of these dolocretes. It is suggested that the occurrence of similar diagenetic setting within carbonate sequence may potentially affect their reservoir characteristics.

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1. Introduction

Most of the dolocrete studies address the various types of nodular and layered pedogenic and groundwater dolocrete profiles that are developed within fluvial clastic formations (Colson and Cojan, 1996; Kadir et al., 2010; Spötl and Wright, 1992; Williams and Krause, 1998). The term cavity-fill dolocrete refers to dolocrete that has been developed within karst cavities. The last decade witnessed excessive studies on clastic deposits within exposed and subsurface karst cavities. Most of these studies focused on hydrogeologic, palaeoclimatic and geochronologic aspects (Baceta et al., 2007; Fornós et al., 2009; Iacoviello and Martini, 2012; Martini, 2011). In contrast to the widespread publications on karst cavity-fill sediments, their diagenesis, particularly dolocretisation, has not received significant attention. Dolocretisation (process of dolocrete formation) is different from dolomitisation. The former results in the addition of dolomite to the host material by direct precipitation, whereas the latter entails the replacement of precursor calcite by dolomite through the reaction of Mg-rich solution (Colson and Cojan, 1996; Khalaf, 1990a; Schmid et al., 2006).

Calcrete and dolocrete profiles within the Mio-Pleistocene clastic deposits in Kuwait have been addressed by Khalaf and El-Sayed (1989), Khalaf (1990a), El-Sayed et al. (1991) and Khalaf (2007). However, exposed karst cavity-fill dolocrete has not been extensively studied. This paper describes a new mode of dolocrete occurrence, which is cavity-fill dolocretes. It presents their petrographic,

mineralogical and geochemical characteristics and discusses their diagenesis and paragenesis.

2. Geological setting

A vertical rock-cut cliff in Al Ahmadi quarry at southern Kuwait, located on the top of Al-Ahmadi ridge (Fig. 1), exposes approximately 30 m thick sequence of the Middle Eocene Dammam Formation and the unconformably overlying Mio-Pleistocene Kuwait Group. The latter is represented by fluvial muddy sands. The exposed part of the Dammam Formation is formed of highly porous chalky dolomicrite grades upward to extensively chertified dolomicrite. The latter is severely karstified where the karst zone is about 10 m thick (Fig. 1).

Karst caves are irregularly scattered within the karst zone; they range in size from tens of centimetres to metres. They are mostly filled with dolocretes. Sharp boundaries between cavity-fill dolocretes and the karstified host dolomicrite are recognised (Fig. 2A). Cavity-fill dolocretes are massive and do not display any nodular or bedding feature. Thin discontinuous accumulations of weathered rusty chert fragments commonly occur at the bottom of the cavity-fill dolocrete. Two types of cavity-fill dolocrete were recognised, namely, mature dolocrete and immature dolocrete (Fig. 2B). Mature dolocrete is present as whitish chalky massive material where remnants of the siliciclastic framework grains of the original sediment can barely be observed. The immature dolocrete is pale greyish to buff in colour with abundant siliciclastic grains. Remnants of greenish and pale brownish siliciclastic muddy sands are observed in some cavities. Chunks of white soft powdery material associated with the some cavity-fill dolocrete and siliciclastic remnants were recognised (Fig. 2C). Collapsed caves are abundant within the karst zone. They

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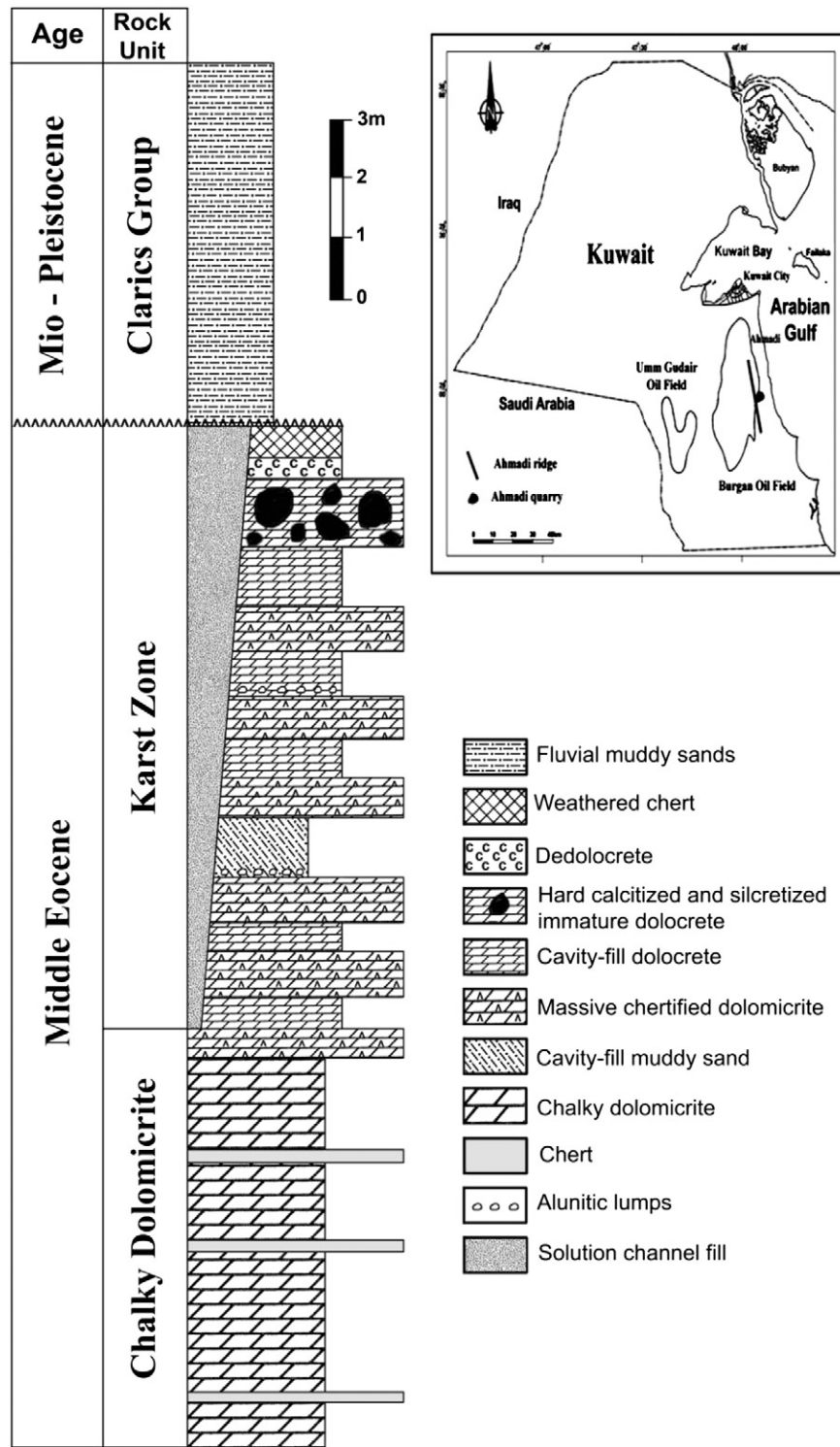


Fig. 1. A simplified lithostratigraphic section of the exposed formations at Al-Ahmadi quarry, the inset is a location map.

are displayed as stacked slabs of host rock (chertified dolomites) separated by cavity-fill dolomite (Fig. 2D). Vertical solution channels, which have been developed along fracture zones, are frequent and are mostly filled with white powdery and chalky material mixed with siliciclastics and fragments of chert and chertified dolomitic.

The upper part of the karst zone (approximately 2 m thick) is formed of extremely hard dense rock and exhibits bizarre patterns that reflect cluttered mixture of dark and light coloured lithologies with blurred boundaries (Fig. 2E). Polished slabs of this rock show

that it is mostly formed by karstified cavity-fill dolomite. Distinctive “Swiss-cheese” pattern of vugs were developed and may reach tens of centimetres in size. They are partially or completely filled with a second generation of cavity-fill dolomite (immature dolomite) (Fig. 2F). The latter is partially karstified, wherein a few centimetre-sized dissolution vugs are completely or partially cemented by silica and/or calcite. These silica and calcite cemented vugs appear as sporadically scattered dark patches within the dolomite giving it the appearance of pseudo-breccia (Fig. 2E).

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