

Chapter 7

Late Devonian Kellwasser Bioevent at Echouech Borehole (EC-1) Southern Tunisia

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ABSTRACT

*To identify and characterise the Kellwasser event in southern Tunisia, which is the subject of this study, we revised the biostratigraphy of the Echouech cores from the late Devonian, particularly Frasnian-Famennian transition. This interval is characterised by diversified fauna. The analysis of ostracod evolution enabled us to identify evidence of Kellwasser events associated with changes in environmental conditions, variations in oxygenation levels characterized by the presence of *Buchiola* and small pyritized ammonoids, a reduction in biodiversity, and the extinction of pelagic ostracods, *Styliolina*, and conodonts. Kellwasser event is marked by black shale horizons in the EC-1 borehole. Geochemical analysis of these horizons confirms the richness of organic matter and the reducing conditions at the base or top of the Frasnian. These horizons are rich in organic matter, reflecting generalized marine anoxia in the EC-1 borehole. A comparison of this event with other boreholes and with the stratotype section was carried out to determine its geographical extension.*

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The EC-1 borehole crossed the Late Devonian (Frasnian-Famennian). The boundary between the two intervals corresponds to the Kellwasser crisis. This limit is set at 374.5 (+ or -) 2.6 Ma. The Frasnian began around 385.3 Ma and covers 10.8 Ma. The Famennian ended at around 359.2 Ma and approximately covers 15.3 Ma (Gradstein et al., 2004). The biomarkers of these two stages are conodonts the Rhenana-Linguiformis Zone of the Frasnian and the Triangularis Zone of the Famennian (Ziegler, 1971; Ziegler & Sandberg, 1990).

In this study, we identified all the groups encountered in this interval (ostracods, bivalves, brachiopods, conodonts, chitinozoans, tentaculitids, and goniatites). The vertical evolution of different biological groups allowed us to identify the Givetien-Frasnian boundary and delineate the Frasnian and Famennian transition. The Frasnian is composed at the base by radioactive dolomites or black limestones corresponding to the Lower Kellwasser and at the top by radioactive facies with poor fauna corresponding to the Upper Kellwasser. Quantitative analysis of ostracods, conodonts, tentaculitidae, brachiopods, and goniatites, allows us to identify any gradual change in the diversity of species or taxa. At the end of the F/F period, several forms became extinct, such as styliolinids, homoctenids, *Nowakia*, *Buchiola*, *Devonoconetes*, and conodonts. Two assemblages of ostracods were identified, marked by variations in the proportion of genera or species. At levels rich in organic matter, the fauna is poor or reduced, characterized by the development of a single taxon. The analysis of organic matter at Kellwassers indicated variations in organic matter from 2 to 5% TOC and a marine origin derived from tasmanacean algae. A comparison of this event was developed with nearby regions, such as Morocco or the Coumiac Montagne Noire reference section.

The Echouech EC-1 borehole (Figure 1) is part of the South license. It is located 20 km from the Tunisian-Algerian border, south of the El Borma field. It was drilled by SITEP in 1970 to study the sedimentological characteristics of the Triassic and Paleozoic deposits. The EC-1 borehole is located to the north of the Ghadames basin, where Devonian deposits have been identified under the Carboniferous at a depth of 2727 m. The borehole was stopped at 3744.5 m. It crossed sediments from the Quaternary to the Devonian. The Late Devonian has a total thickness of around 723 m (2305–3028 m).

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