

EMSIAN-GIVETIAN STROMATACTIS-CORAL HYDROTHERMAL MUD MOUNDS, TAFILALT-MAIDER, MOROCCO

LOCALITY. – Emsian to Givetian, warm temperate mixed siliciclastic open carbonate ramp (Tafilalt-Maider Basin, Morocco). Northern continental margin of the West-African Craton (40-70° S).

STRATIGRAPHY. – Kess-kess mounds and Hollard mound from Hmar Laghdad. 48 mounds starting at different levels are observed in an 0.5 x 3.5 km area. The mounds are cone-shaped, subcircular in horizontal cross-section and up to 50 m high. Flanks are steeply dipping (35-60°) (Brachert *et al.* 1992). The formation developed on the top of a Lochkovian 100 m-thick basaltic volcanic high. The upper surface of this volcanic high was first colonized by crinoids (~180 m of crinoids sands, of Praguian-Early Emsian age), then by the mounds themselves. Kess-kess mounds were buried by Emsian shale. Later, a second mounding event is represented by the Eifelian-Givetian Hollard mound (Mounji *et al.* 1998).

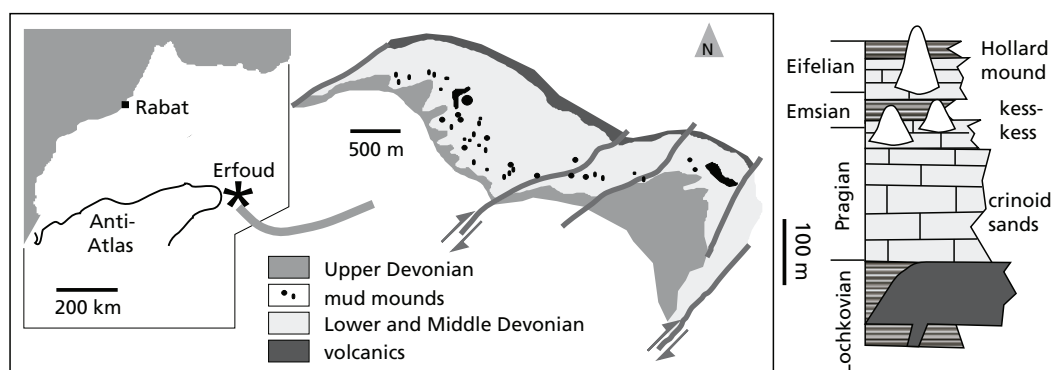
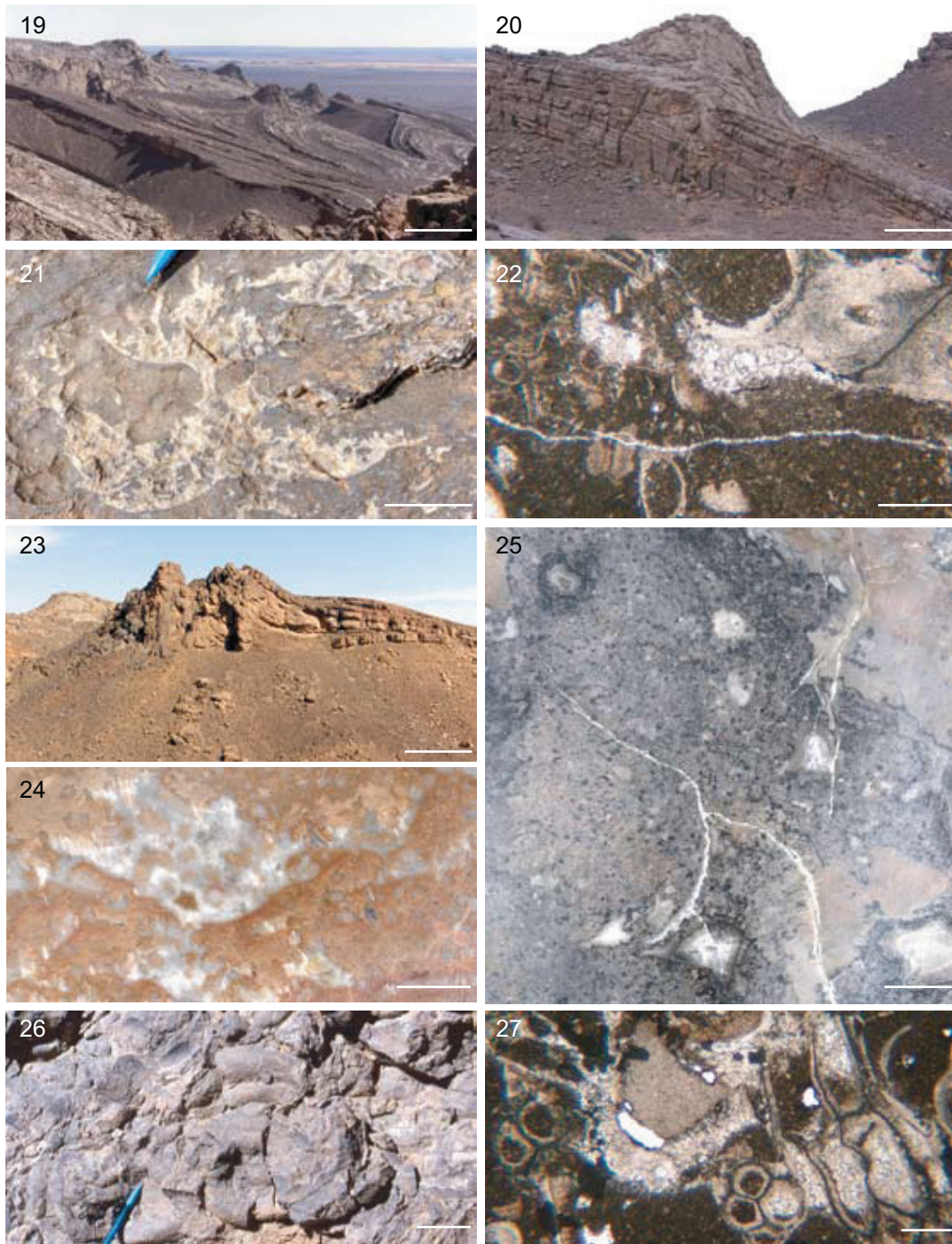


FIG. 18. Geological sketch of the Tafilalt-Maider area and stratigraphic sketch with setting of mud mounds.

FACIES AND MICROFACIES (Figs 11-17). – Grainstones and packstones with crinoids and subordinate brachiopods, trilobites, bryozoans, tentaculitids and tabulate coral form the sole of the kess-kess mounds. The kess-kess cores are massive mudstones to wackestones with tabulate corals (auloporids, thamnoporids, favositids) and subordinate crinoids, trilobites, brachiopods and tentaculitids. Early marine cemented fenestrae (including stromatactis) are frequent. Intermound facies correspond to well-bedded tentaculitid-coral mudstones and wackestones. The younger Hollard mound shows approximately the same core facies as the kess-kess, with additional dissolution cavities, central dykes and large bivalves communities. Cover beds of the Hollard mound are reddish fine-grained limestones with fenestrae. Syndimentary fracturing of mound, intermound and sole limestones are dated as Emsian to Famennian.



FIGS 19-27. **19**, The Emsian kess-kess mounds of Hmar Laghdad; scale = 25 m. **20**, A 20 m-thick kess-kess interfingering with well-bedded intermound limestones; scale = 10 m. **21**, Kess-kess facies: fine-grained limestone with stromatactis and tabulate corals; scale = 3 cm. **22**, Kess-kess facies: wackestone with aulopodid, brachiopods, fenestra; thin section, plane polarized light; scale = 1 mm. **23**, The Eifelian-Givetian Hollard mound; scale = 20m. **24**, Hollard mound cover beds: fine-grained reddish limestones with stromatactis and corals; scale = 1 cm. **25**, Hollard mound, core facies: dark grey peloidal spar in probable dissolution cavities; scale = 0,5 cm. **26**, Hollard mound, core facies: bivalves embedded in vent carbonates; scale = 7,5 cm. **27**, Hollard mound cover beds: wackestone with tabulate corals, crinoids and fenestrae; plane polarized light; scale = 1 mm.

BIODIVERSITY AND TAPHONOMY. — All Hmar Laghdad mounds are dominated by a rather homogeneous tabulate corals-crinoids community. No vertical or lateral differentiation is observed. Inter-mound beds show the same community with a more developed fine-grained bioclastic fraction. The Hollard mound shows dykes-associated bivalve communities in the central part of the core (Belka 1998; Mounji *et al.* 1998).

DISCUSSION. — The conical shape and the location of the mounds itself suggest an accretion related to a hydrothermal venting system, due to thermal flux above the volcanic rock pile (Mounji *et al.* 1998). Circulation of fluids through the dykes was responsible for precipitation of synsedimentary cements and mud. Lack of algae and minor reworking by waves point to a relatively deep-water setting, under the photic zone and storm wave base. The isotope geochemistry of the Hollard mound suggests a possible contribution from thermogenic methane (Belka 1998).

REFERENCES

-
- BELKA Z. 1998. — Early Devonian Kess-kess carbonate mud mounds of the Eastern Anti-Atlas (Morocco), and their relation to submarine hydrothermal venting. *Journal of Sedimentary Research* 68: 368-377.
- BRACHER T. C., BUGGISH W., FLÜGEL E., HÜSSNER H. M., JOACHIMSKI M. M., TOURNEUR F. & WALLISER O. H. 1992. — Controls of mud mound formation: the Early Devonian Kess-kess carbonates of the Hamar Laghdad, Anti-Atlas, Morocco. *Geologische Rundschau* 81: 15-44.
- MOUNJI D., BOURQUE P.-A. & SAVARD M. M. 1998. — Hydrothermal origin of Devonian conical mounds (kess-kess) of Hamar Laghdad Ridge, Anti-Atlas, Morocco. *Geology* 26: 1123-1126.