Supplementary 4

Further details on micromorphology

6Bg5 horizon (312 – 355 cm depth)

A soil thin section was prepared from the central part (329 – 339 cm depth) of the 6Bg5 horizon. This horizon is characterized by a compacted granular to crumbly microstructure, channel microstructure and partly spongy microstructure, with a moderate to high degree of separation (Fig. 4a / main text). Planes, elongated voids, channels, vughs and mammillated vughs are characteristic. The groundmass comprises much coarse material, leading to a coarse to fine ratio $c/f_{50\ \mu m}$ = 2:1. Redoximorphic features are distinct, including numerous concentric, aggregate, typical, and geodic ferruginous nodules and ferruginous/manganiferous hypocoatings on weathered dolomite (Fig. 5a, 5b / main text). Loose to compacted crumbly discontinuous incomplete infillings and numerous passage features are most prominent throughout the thin section (Fig. 4a / main text). Sparite and micritic nodules occur in channels. The finemass is non-calcareous with stipple speckled and partly granostriated b-fabric. The dolomite is most probably a remnant of sandstone that is rich in glauconite and dolomite. A less weathered fragment occurs in the thin section of the 5Bg4 horizon (Fig. 4b / main text). The manganiferrous/ferruginous hypocoatings most probably protect it against weathering. This might explain the occurrence of such large dolomite crystals in an otherwise completely decarbonated horizon.

5Bg4 (300 – 312 cm depth)

A soil thin section was prepared from the central part (301 – 311 cm depth) of the 5Bg4 horizon. This horizon is characterized by channel microstructure. Related to the intense bioturbation (numerous passage features), subangular blocky to compacted crumbly microstructure often occurs in infillings (Fig. 4b / main text). Loose to dense crumbly, discontinuous to continuous infillings can be found throughout the thin section. Fragments of mollusk shells, micritic nodules, abundant sparite and biogenic calcites occur generally related to passage features (Fig. 5c / main text). Further coarse components include rock fragments, sometimes with calcareous portions, with a diameter of up to 3 mm (Fig. 4b). The $c/f_{50\ \mu m}$ ratio is 2:1. The groundmass is generally non calcareous and has a stipple speckled to undifferentiated b-fabric. Ferruginous concentric and aggregate nodules occur frequently.

3Bw1 (220 – 260 cm depth)

A soil thin section was prepared from the central part (230 – 240 cm depth) of the 3Bw1 horizon. This horizon is characterized by lenticular platy to compacted crumbly microstructure with a moderate degree of separation. Planes, elongated voids, channels, vughs and mammillated vughs are characteristic. Link cappings occur now and then between lenticular plates. Ferruginous aggregate and concentric nodules and ferruginous hypocoatings on rock fragments frequently occur. Loose to compacted crumbly and granular incomplete infillings and numerous passage features occur throughout the thin section (Fig. 4c, 4d / main text). Micritic calcium carbonate that is finely dispersed across the groundmass causes crystallitic b-fabric. Fragments of mollusk shells, micritic nodules or peloids, sparite and numerous biogenic calcites as well as rock fragments occur as components of the coarse material of the groundmass.

2Bg1 (190 – 220 cm depth)

A soil thin section was prepared from the central part (202 – 212 cm depth) of the 2Bg1 horizon. The thin section is dominated by weakly developed lenticular platy microstructure and crumbly microstructure (Fig. 4e / main text). Crumbs have diameters of up to 1.2 mm. Planes, channels and (mammillated) vughs are characteristic. Numerous loose crumbly discontinuous and continuous fillings are distributed across the thin section (Fig. 4e / main text). All of them can be described as passage features as well. The content of coarse material in the groundmass is rather high, resulting in a $c/f_{50\ \mu m}$ ratio of 4:1. Few fragments of weathered chert occur as coarse material in the groundmass. Micritic calcium carbonate finely dispersed across the groundmass produces a crystallitic b-fabric. Micritic peloids, sparite, fragments of mollusk shells and biogenic calcite occur as well (Fig. 5d / main text), and some ferruginous concentric nodules are present.

Cg2 (150 – 190 cm depth)

A soil thin section was prepared from the central part (163 – 173 cm depth) of the Cg2 horizon. The characteristic microstructure is lenticular platy with well to moderately developed pedality (Fig. 4f / main text). Voids include partly accommodating planes, channels and mammillated vughs. Generally only a minor portion of coarse material was found ($c/f_{50\ \mu m}$ ratio 1:9). The coarse grains have diameters of 90 – 200 µm and occur in continuous, complete silt and fine sand infillings. Micritic calcium carbonate, finely dispersed across the

groundmass, produces a crystallitic b-fabric. Weakly developed micritic hypocoatings around channels indicate some secondary accumulation of calcium carbonate. Few passage features (continuous complete fillings) point to activity of soil mesofauna throughout the thin section (Fig. 4f / main text). Some of the fillings have lenticular platy microstructure (Fig. 5e / main text). Few dusty, dark brown clay coatings occur (Fig. 4f / main text).