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Micromorphology in unconsolidated landslide sediments – investigating mass movement deposits at a different scale

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In order to reliably reconstruct a landslide event, its triggers, movements and the main factors of influence, a profound knowledge of the slide masses' inner architecture and their internal processes is of great importance. As van der Meer (1996) states, micromorphology permits a complete examination of particles, matrix and all components contained in unconsolidated sediments, as well as an insight into their internal arrangement. So far, thin sections and micromorphology are mainly used for studying marine, periglacial and glacial sediments (e.g. Maltman 1988; van der Meer 1993, Menzies 2000, van Fliet-Lanoe 2010, van der Meer & Menzies 2011). Comparatively little work has been carried out with a focus on landslides (e.g. Bertran & Texier 1999).
Therefore, our work is a first attempt at investigating unconsolidated deposits of landslides in the low mountain areas of southern Germany using micromorphological tools. The objective was to observe sedimentary microstructures in order to gain an understanding of the sediments' internal movement, deformation etc. during a slide event. On the investigated landslides near Ebermannstadt (Franconian Alb), Gailnau (Frankenhöhe region) and Talheim (Swabian Alb) samples were taken from small pits or outcrops (depths between 50 cm – 300 cm below the surface) in the upper, central and lower part (foot) of the slide mass.
The thin section analyses revealed several differences between the three environments and within the specific landslides themselves. Most prominently, several structures (e.g. water-escape-structures, flow-noses and rotational structures) indicate a crucial impact of water in all three slide masses. Furthermore, the thin sections showed heterogeneous compositions of different sediment materials and aggregates, presumably transported, mixed together and deformed during the slide movement. In Ebermannstadt and Talheim, several ductile and brittle deformation structures (rotational structures, marbled structures, fractures, crushed grains) were obvious in those deposits, proving a rather turbulent mass movement with pervasive pressure and stress and varying phases of deformation. In contrast, thin sections from Gailnau only provided very slight deformation structures, which lead to the assumption of a completely different and steadier type of movement with less pressure. Downslope, samples from all landslides showed accumulations of broken fragments with plasma filling out (parts of) the joints, while samples from the front areas (foot) revealed plasma-dominated, structureless, homogenized sediments with varying amounts of sand particles but with few fragments in it. This leads to the assumption of water-saturated plasma being squeezed out of the main accumulation body during its deposition, creating a flow-type movement in the foremost part of both landslides.
The results significantly improved the understanding of the behavior of the landslides as several details in terms of processes and structures could be revealed. The micromorphological analyses also helped to validate presumptions gathered from geomorphological mapping and geophysical soundings.
Although continuing research into the microstructure of landslide deposits is necessary, our investigations already illustrate the potential value of micromorphology in this environment.

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