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Evolution of soil pore properties over 10kyr in alpine settings

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High-alpine areas typically exhibit young and shallow soils, as retreating glaciers gradually expose new terrain to the atmosphere. The ensuing physical and chemical weathering brings an alteration of the young soil's physical and chemical properties which also propagates in depth with time. The increase in fine particles also changes the hydrological properties. It is clear that flow pathways and chemical weathering in the soil depend strongly on pore size abundances, geometry and interconnectivity, and that these properties change over time. It is, however, unexplored how and at which rate such changes occur. X-ray Computed Tomography is a useful tool to gain insight into the physical structure of soils without disturbing it. So far, it has not been used in evolving soils. In an attempt to close this knowledge gap, we sampled two chronosequences in the Swiss Central Alps, covering 10'000yrs of soil development. These two chronosequences enabled a comparison of soil physical development on two different substrates, namely a silicate and carbonate geology. We analysed the macro- and mesopores of the upper 5 cm of the soils developing on slopes of moraines of known ages. Using X-ray Computed Tomography, we aimed at detecting age trends of the soil pores and quantifying them. We hypothesised that macropores are with time increasingly replaced by mesopores. A significant development can, however, only be detected in the topsoil. Soil evolution is considered to proceed slower on calcareous material. Consequently, the increase over time in tortuosity and soil pore connectivity is slower.
The results showed that X-ray Computed Tomography is a suitable method to observe age trends and the subsequent evolution of soil pores. Strong soil surface erosion, however, tends to overprint this effect by constantly rejuvenating the terrain surface. This new approach of applying X-ray tomography on chronosequences opens possibilities in better understanding the evolution of the physical properties of soils and its influence on the hydrological cycle.