Gravel with crystalline components on the helvetic border chain (Sieben Hengste area)

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The Sieben Hengste area is located in the Bernese Oberland, east of Interlaken, and is part of the helvetic border chain. The helvetic border chain consists of cretaceous and tertiary sediments. Surprisingly gravel with crystalline components is found on the surface and in caves at places where no alpine glaciers are known to have ever overflowed.
Due to the cretaceous Schrattenkalk the Sieben Hengste form today a karst plateau of ca. 2 km^2. At the southern margin, the Schrattenkalk is overlaid by the Tertiary Hohgant-Formation, consisting mostly of more or less quartz-rich sandstones and Globigerinen-Mergel. Nearby outcrops of Habkern- / Schlierenflysch and of the prealpine Klippen nappe (Giswiler Klippen) exist also.
From 1600-1870 m (asl) a sandy, loamy gravel is found in different sediment traps, as caves, hollows, dolines and waterless runs (Fig. 1). The largest outcrop lies in a line of hollows and runs in a length of about 1 km between Oberberg and Wagenmoos (*Coord. 629.375/177.875*). A 2 m deep profile not reaching the bedrock shows an unlayered, compact sediment under 50 cm of Braunerde. It looks like a mudflow, in no way adjusted and woozily poured. Half of the pebbles are non-rounded sandstones and marls originating from the nearby Hohgant-Formation. The other half is well rounded, consisting of various limestones indicating a fluvial transport. Among them 3-5% of crystalline and metamorphic material can be found: granite, gneiss, mica, amphibolite, a lot of quartz, quartzite and a few ophiolites like serpentinite.
In this context there are two questions, which are of high interest: where does this sediment originate and which process did remove it at this place? Former authors (Minet 1971, Jeannin 1989) considered them as (fluvio)-glacial sediments. But at first sight there is no evidence for glacial transport. The sediment doesn't look like lodgement till: it's not matrix supported, not adjusted and fissures of unloading, scratched pebbles and erratic boulders are missing. Furthermore any characteristic petrography for Aare- or Rhone-Glacier, as Aare-Granite, Grimsel-Granodiorite, Mont-Blanc-Granit, Allalin-Gabbro, Arkesin or Vallorcine-Konglomerat, is absent too. A direct fluvial deposit in this karst plateau is impossible, as there are usually no streams. Most of the outcrops are located in caves. The sediment appears already in the oldest part of the Sieben-Hengste-Hohgant cave-system (the uppermost part). First results by burial-age dating let assume a minimal age of the first sedimentation of about 2 Ma (pers. comm. Philipp Häuselmann). The two detected deposits on the surface lie along faults. Two interesting details of the Wagenmoos outcrop attract attention. At the southern margin large boulders of a collapsed sandstone bank slightly out of place are found. At the northern margin a little stream has its source in the swamp of Wagennoos. It's eroding the sediment and transporting it into the doline nearby: the next deeper sedimentation level. The boulders out of place seem to indicate a former, now unroofed cave system along the visible fault.
As to the crystalline petrography, we find hardly an analogy in the Aarmassif. Especially for the serpentinites there is no equivalent. Some of the granites, gneisses

and micas could eventually originate in the Schlieren- / Habkern-Flysch. But neither amphibolites nor serpentinites or quartz with crystals are known therein. The same applies for the Klippen-Decke. Therefore the Valais seem to be up to now the only plausible area of origin.
The direction of transport could be for different reasons from west to the Eriz valley, which is older than the development of the Sieben-Hengste-Hohgant cave-system (Häuselmann 2002). All outcrops are to the West of Grünenberg-Pass, where the Eriz valley begins. Sedimentary flysch-breccia (Habkern- / Schlieren-Flysch consists mainly of crystalline components) found in the Sieben Hengste area reminds of Prealpine-flysch. In the Stockhorn area, on the north side of the Simmental, sediment outcrops are found in the same altitude as Sieben Hengste with a similar petrography.
As no glaciations in the Swiss Alps are evident older than 2 Ma and no other evidences suggest a glacial transport or sedimentation, we assume, that a fluvial system coming out from a former Ur-Simmental deposited the examined sediments on the Helvetic border chain before the Sieben-Hengste-Hohgant-cave-system was developed. Maybe this fluvial system originated no more in the Valais at that time, but transported older deposits from there further to the East. With the evolution of the Sieben-Hengste-Hohgant cave-system the sediment was filled by rain- and meltwater in the caves. When the cave system got deepened following the deepening of the corresponding karst level, older cave channels became dry. Thus sediment deposits lying therein were trapped (Häuselmann 2002). When channels became unroofed by erosion, as can be observed today in the Wagenmoos, the pebbles were transported smoothly to the next deeper sediment-trap.

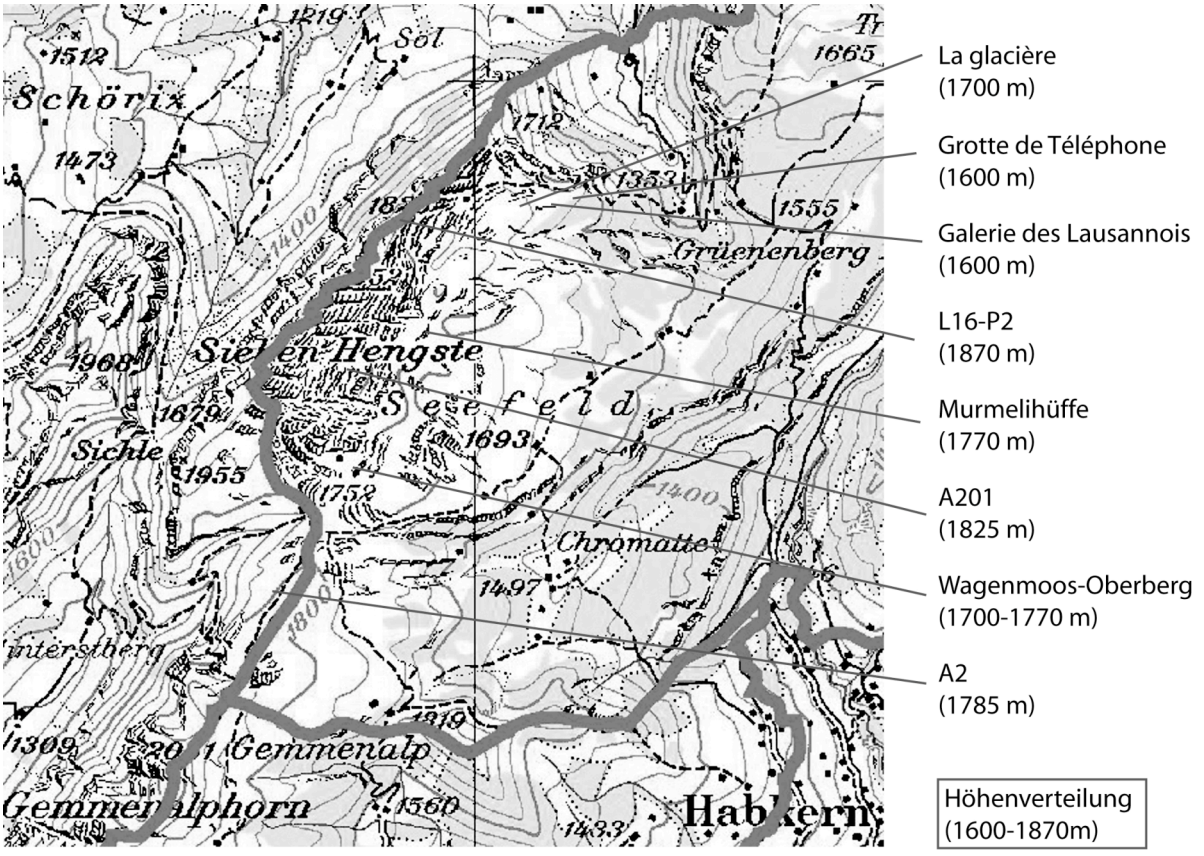

Figure 1. Outcrops at the Sieben Hengste (altitude in m asl).

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