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Quantification of holocene valley fill deposits in an alpine basin, Southern French Alps

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A 3D palaeotopographic modeling is proposed to quantify the sediment budget of a small subalpine catchment (5 km^2) over the last postglacial period in Southern French Alps. Originality of these catchment formations is to hold many charcoal beds and subfossil trees which allow radiocarbon dating. Therefore, this basin provides a well-constrained sequential chronology since the Lateglacial to allow a temporal quantification of the source to sink sediment fluxes. Methods consist in a GIS-integrated geomorphometric field mapping in order to re-shape the Digital Elevation Model (DEM) of the actual topography.

The Charanc basin is localized on the right-side of the Durance River (44°30'44 N / 5°51'55 E). The hill-slope landscape (500 to 2000 m asl.) is characterized by extended black marl outcrops (Callovo-Oxfordian) which are dominated by rill erosion processes. Due to their susceptibility to weathering processes, these badlands have supplied an abundant sediment load during the Postglacial. Two-stage of periglacial remains cover the footslopes in the shape of depositional glacis. After LGM, morphogenetic evolution of the river beds shows a phase of vertical incision due to reduced detritical flow during the first part of the Lateglacial period. Then the sedimentation begins around 12500 BP. Alluvial formations of loamy material are recorded only in the lower part of the basin (Drouzet valley). Between 12500 BP and 6900 BP clayey debris deposition occur closed to the slopes. These very spread-up deposits represent coalescent colluvio-alluvial fans-shaped (Main Postglacial Infilling - MPI). This in-fill of 15 meter-thick is widely documented by numerous morphosedimentological studies. The sedimentation sequence ends around 6900 BP, and is followed by a linear incision phase to the actual. The main morphodynamic of incision for the second Postglacial is only interrupted by thin and scarce alluvial drifts.

The geomorphologic surveys assisted by GPS are input in a GIS to produce an accurate map of the outcrop remains. We use each storage and delivery area as a mask of the actual DEM, which we add elevation reference points plotted on field. Three DEM are computed, representing the topography: (i) of the end of the Pleistocene (LGM) by regularized slopes, (ii) before the enlargement of the torrential impluvium on slope and the before the MPI deposition, (iii) at the end of MPI, before the incision phase. To spatialize and to quantify input and output volumes, the elevation subtraction of these re-shape DEMs have been computed.

Over the Lateglacial (20 000 to 12500 BP), 36 million m3 of sediment are eroded from the slopes and exported directly to the upper order stream without intermediate storage (300 m3/yr). The volume of eroded sediment from slope is 14 millions of m3 from 12 500 BP to the current topography. Only 8 millions of m3 of sediment have leaved were exported out of the catchment. 50 % is provided from the marl slopes and 50 % from the MPI linear incision. Therefore at the temporal scale of the Postglacial, soil erosion rate is 550 m3/yr. Especially from the MPI, where the colluvio-alluvial deposits are pretty readily re-workable, minimum soil erosion rate is 500 m3/yr ranging from 6900 BP to 2000 AD.

These results make clear modalities of the soil erosion for the Postglacial. Erosion rates are relatively large

and constants for this period even if we can note a low-rate increase over the seven last millennia. Comparison between the first and the second Postglacial seems to indicate a switch of sediment suppliers at the temporal scale. Soil erosion will take place onto the slope by regressive erosion between 12500 to 6900 BP. The main sediment supplier since 6900 will be the easily re-workable deposits on the valley bottom, by linear incision processes.