Supplement to:

Somme, T.O., Piper, D.J.W., Deptuck, M.E., and Helland-Hansen, W., 2011, Linking onshore–offshore sediment dispersal in the Golo source-to-sink system (Corsica, France) during the late Quaternary: Journal of Sedimentary Research, v. 81, p. 118–137.

This supplement provides a more thorough description of the methods used to calculate volumes of onshore terraces, shelf depositional units and deep-sea fan lobes. We also discuss a number of assumption associated with the calculations and some of the main uncertainties that are incorporated in the estimates.

Onshore terraces

Terrace volumes are calculated somewhat differently for Reach 2 and 3, and for the partly subsurface extent of the terraces in Reach 4 and on the shelf. The amount of preserved (N3–N6) alluvial cover on the strath terraces in Reach 2 and 3 is simply calculated by their aerial extent (Fig. 2), using an average cover thickness of 1.5 m, which is representative for the cover close to the present river. There are no exposed terrace sections close to the valley margins, so it is possible that the amount of material overlaying the straths varies away from the river causing under- or over-estimates of the amount of preserved terrace sediment. The terrace areas are obtained by intersecting a gridded terrace tread surfaces, and a regional digital elevation model (DEM) with ~30 m resolution. The grids are constructed by interpolating tread elevations (measured by high resolution GPS), thus resembling a reconstructed valley floor at the time of maximum alluvial aggradation. By subtracting the respective terrace surfaces we can also calculate first order volumes of rock eroded during each period of lateral erosion and strath formation (Table 2); however, the uncertainty is expected to be large for the youngest N6 terrace which commonly is confined in relatively deep gorges and which is poorly resolved in the DEM. Also, the rock volume for the older N3 and N2 is probably overestimated as the valleys have been widened after strath formation by general slope regression.

There are also uncertainties associated with the calculation of sediment storage on the Marana alluvial plain (Reach 4), as both the sea-level stand at the time of terrace formation (and thus the aerial extent) and the subsurface thickness in poorly known. Estimated terrace volumes on the Marana plain are therefore based on three main assumptions: i) that the approximate shoreline position at the time of terrace deposition can be estimated by the inferred terrace ages and the corresponding eustatic sea-level stands at the time of their formation, suggesting depths of ~40–60, ~100–120, ~70–110 and 50–90 mbpsl for the N6–N3 terraces, respectively; ii) that the terraces have a relatively uniform thickness within the range reported by Conchon (1977) and Conchon (1978) suggesting ~10, ~20, >10 and ~4 m for the N6, N5, N4 and N3 terraces, respectively; and iii) that significant terrace deposition by the Golo River is limited to a triangular area on the Marana plain and on the adjacent shelf that is bounded by the South Golo Canyon to the south and the St. Damiano and Biguglia Canyons to the north (Fig. 1C). This triangular area is thus inferred to cover the northern and southern most position of the Golo River on the shelf. The latter assumption implies that some of the smaller rivers located between the Golo, Bevinco, and the Fium Alto Rivers, such as the Mormorana, Rasignani and the Arena Rivers (Fig. 1C) also contributed to terrace formation along the Marana plain.

Uncertainties in the calculated volumes are caused by the variance in thickness reported from each terrace level and the uncertainty related to terrace area extent at the time of deposition. Additional uncertainties could result from even higher thickness variations, both laterally and down-dip. These calculations also estimate sediment storage at the time of deposition, and parts of the alluvial record have been subsequently removed by erosion and incision.

Offshore shelf units

When estimating shelf storage, we define the Golo shelf area as previously described: bounded by the northern and southern canyons inferred to have fed sediment to the Golo Fan. This area covers ~127 km^2 of the shelf platform (Fig. 10).

Good control on thickness and down-dip extent of the shelf units is only possible in areas covered by seismic lines. Here, volumes of individual depositional units are calculated by gridding seismic horizons.

Along strike, where seismic coverage is poor, we extrapolate observed thickness along the isobaths assuming that thicknesses are depth related. Although this is a clear over simplification, the errors are considered relatively low considering the relatively small geographic area covered, and the dominant wave controlled morphology of the Golo shoreline and shelf. Post-depositional erosion and reworking also influences the calculations. Compensational stacking, removal by longshore currents and channel incision are other factors that may cause uncertainties in the volume calculations. The entire shelf volume is treated as sand, and no adjustments have been made to compensate for porosity variations in the offshore sediment.

Deep-sea fan lobes

Estimates on sediment volumes in the deep-sea fan lobes are also based on gridded surfaces. These include the regional seismic reflectors between the sea floor and the I marker, as well as local surfaces defining the base and top of individual lobes. These individual bounding surfaces mark the transition between high-amplitude hyperbolic and chaotic reflectors, which are interpreted to represent small channels, scours and amalgamation of sandy sediments, and transparent and parallel reflectors which represents fine-grained turbidites and hemipelagic sediments (Deptuck et al. 2008). The base and top bounding surfaces in each lobe are then gridded to create isochore thicknesses maps which give an estimate of the total amount of sand trapped in the individual composite lobes (Table 4). The combined volumes of these sandy deposits are then subtracted from the overall volume between the I, J, and K markers and the seafloor to obtain an approximation of the overall sand and mud content in the system (Table 4). The volume of fine-grained drape was estimated by averaging between 23 cores across the basin (Gervais 2002), which suggest a overall thickness of 1.7 m.

Uncertainties in the offshore volume estimates are generally below 5% due to gridding techniques, however, composite lobes that are located on the fan margin and which are covered by few seismic lines may cause uncertainties up to 15%. Additionally uncertainties are associated with estimation of sand and mud fraction in heterolithic fringe, channel and levee deposits. No attempts have been made to account for any loss or gain of mud on the shelf or slope by shelf- or deep-sea currents (Marani et al. 1993). Naturally, the fan lobes are the only deposits that actually record the long-term supply of sediment delivered to this segment of the source-to-sink system, and in contrast to the onshore and shelf part of the system, there is little potential for later erosion and redistribution of sediment in this area.

References

CONCHON, O., 1977, Néotectonique en Corse orientale d'aprè l'étude des formations quaternaires: comparison entre la Maranan et al plaine d'Aleria: Bulletin de la Societe Geologique de France, v. 7, p. 631-639.

CONCHON, O., 1978, Quaternary studies in Corsica (France): Quaternary Research, v. 9, p. 41-53.

DEPTUCK, M.E., PIPER, D.J.W., SAVOYE, B., and GERVAIS, A., 2008, Dimensions and architecture of late Pleistocene submarine lobes off the northern margin of East Corsica: Sedimentology, v. 55, p. 869-U34.

GERVAIS, A., 2002, Analyse multi-échelles de la morphologie, de la géométrie et de l'architecture d'un système turbiditique sableux profond (Système du Golo, Marge est-Corse, Mer Méditerranée) [Ph.D. Thesis]: L'Universite Bordeaux I, 315 p.

MARANI, M., ARGNANI, A., ROVERI, M., and TRINCARDI, F., 1993, Sediment drifts and erosional surfaces in the central Mediterranean - seismic evidence of bottom-current activity: Sedimentary Geology, v. 82, p. 207-220.