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Theoretical cosmogenic nuclide concentrations in pebbles along river path

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We analyse theoretically the relative contributions of transport processes to TCNs concentrations in pebbles. We aim at linking concentrations and scattering with initial sizes distribution, pebble abrasion rate, river length, alluvial thickness, fluvial transport velocity and hillslopes erosion rate. We develop a numerical model to calculate the concentration at a pebble center on hillslopes (depends on pebble size and erosion rate) and along a main river path. Pebble transport in river depends on the probability of pebble burial under alluvial cover (this depends on pebble size) or within adjacent terrace. The transport velocity depends on pebble's size and size decreases by abrasion. Below a specified size, pebbles are transported farther than river outlet. We run the path of numerous pebbles and we analyse statistically their concentrations at river outlet. To compare experiments, we define the variability as the scattering of concentrations normalized by the mean concentration of the population.
Results shows that the main variability is due to the different source locations of pebbles in the catchment. Pebble abrasion tends to decrease the variability because it reduces the source area of pebbles bedload to the downpart of catchments. This suggests that catchment-scale erosion rate corresponds to limited area of large catchments which can be quantified for a given abrasion rate. Alluvial riverbed cover increases very much concentration in small pebbles, and much less in large pebbles. Hillslopes versus river inheritance varies with river length, hillslope erosion rates and river transport rate as shown earlier (e.g. Repka et al, 1997) but we show that it can also vary with pebble radius and abrasion rate. Thus, combined effects of alluvial river bed, pebble abrasion, and size dependence of transport velocity is an explanation of observed dependence of concentration with pebble size. Such a dependence can be quantified analytically with approximate solutions for concentrations function of all parameters.