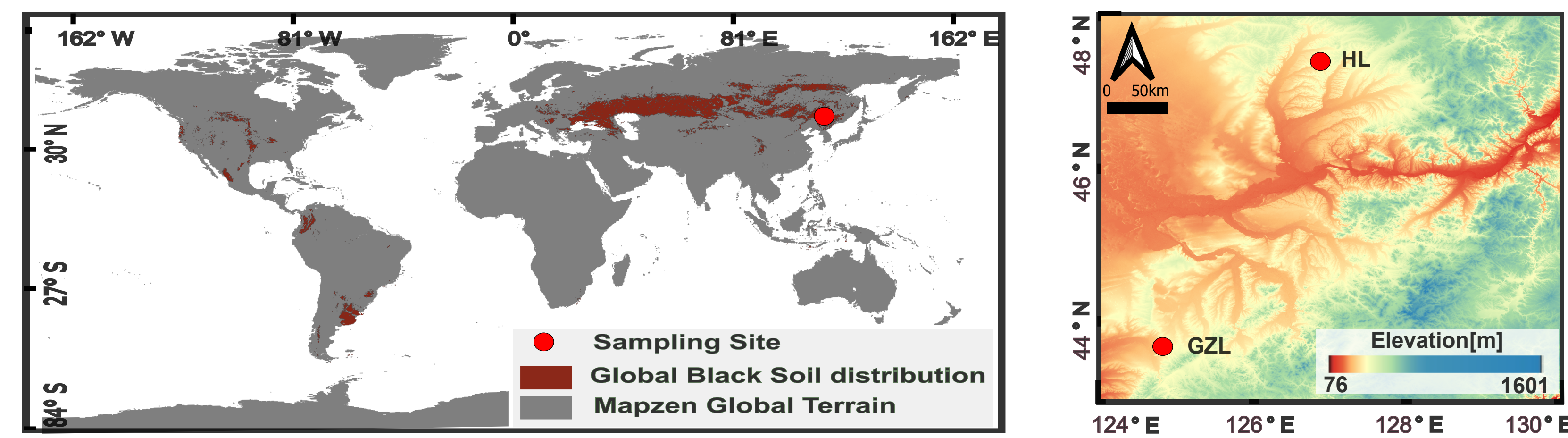


Why does carbon stabilization lag behind sediment redistribution? Single-grain luminescence dating and modelling insights

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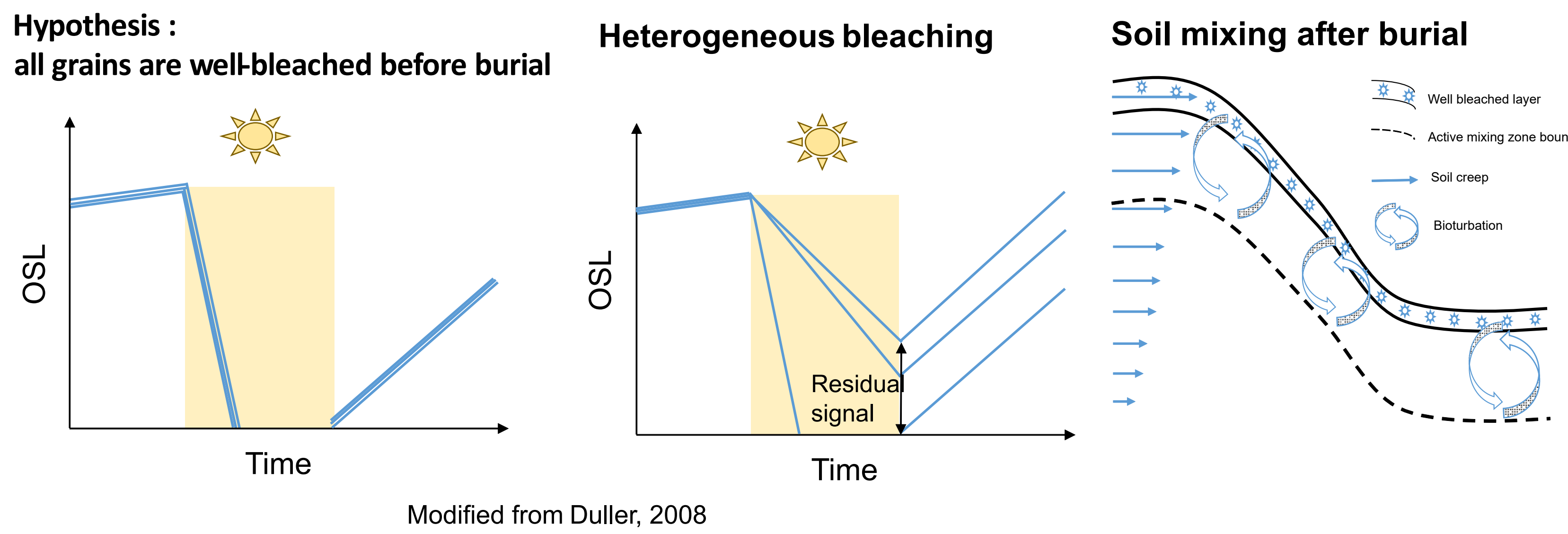
Common assumptions in landscape-SOC models:

1. Carbon flux = Sediment flux × Carbon concentration
 2. No post-depositional soil reworking
- Implication: erosion redistributes SOC, curvature governs carbon loss and accumulation (Kwang et al., 2022; Thaler et al., 2021)



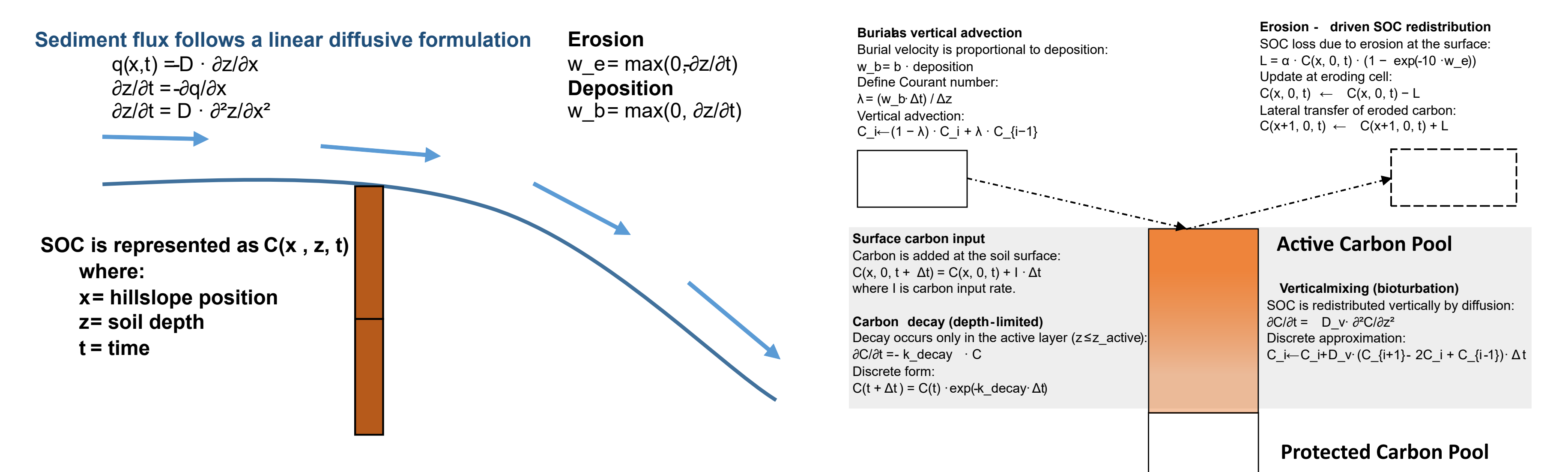
How to trace vertically and laterally moving sediment?

Single grain luminescence Age(kyr) = Equivalent dose(Gy)/Dose rate(Gy/kyr)

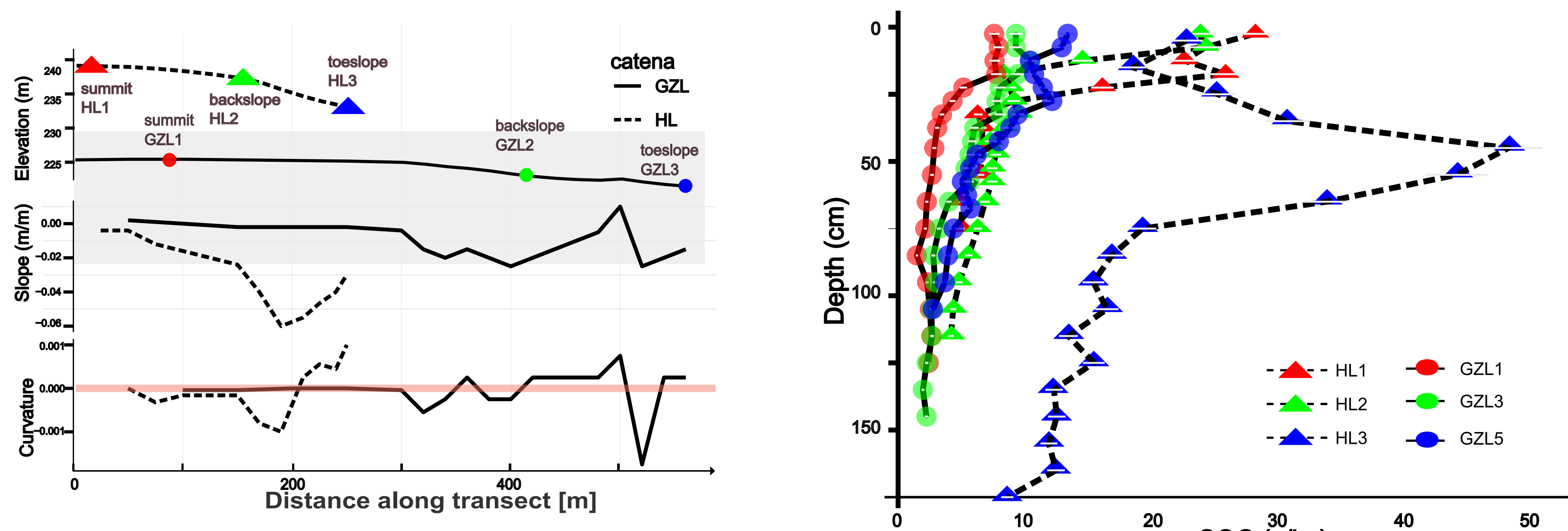


How to trace vertical and lateral carbon gain/loss?

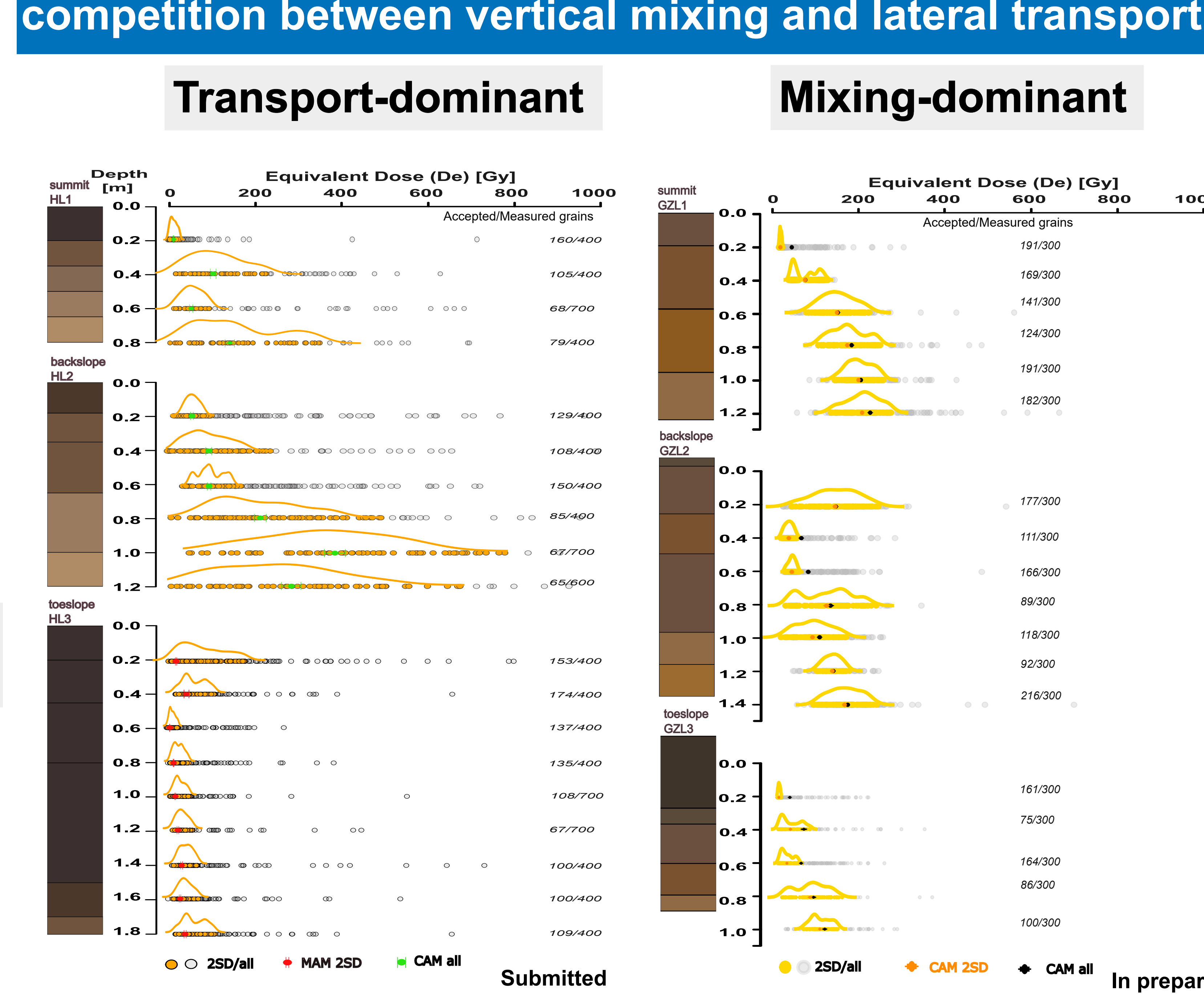
1D reactive transport model of organic carbon in sediments



Why does steep catena preserve more carbon than a gentler one?

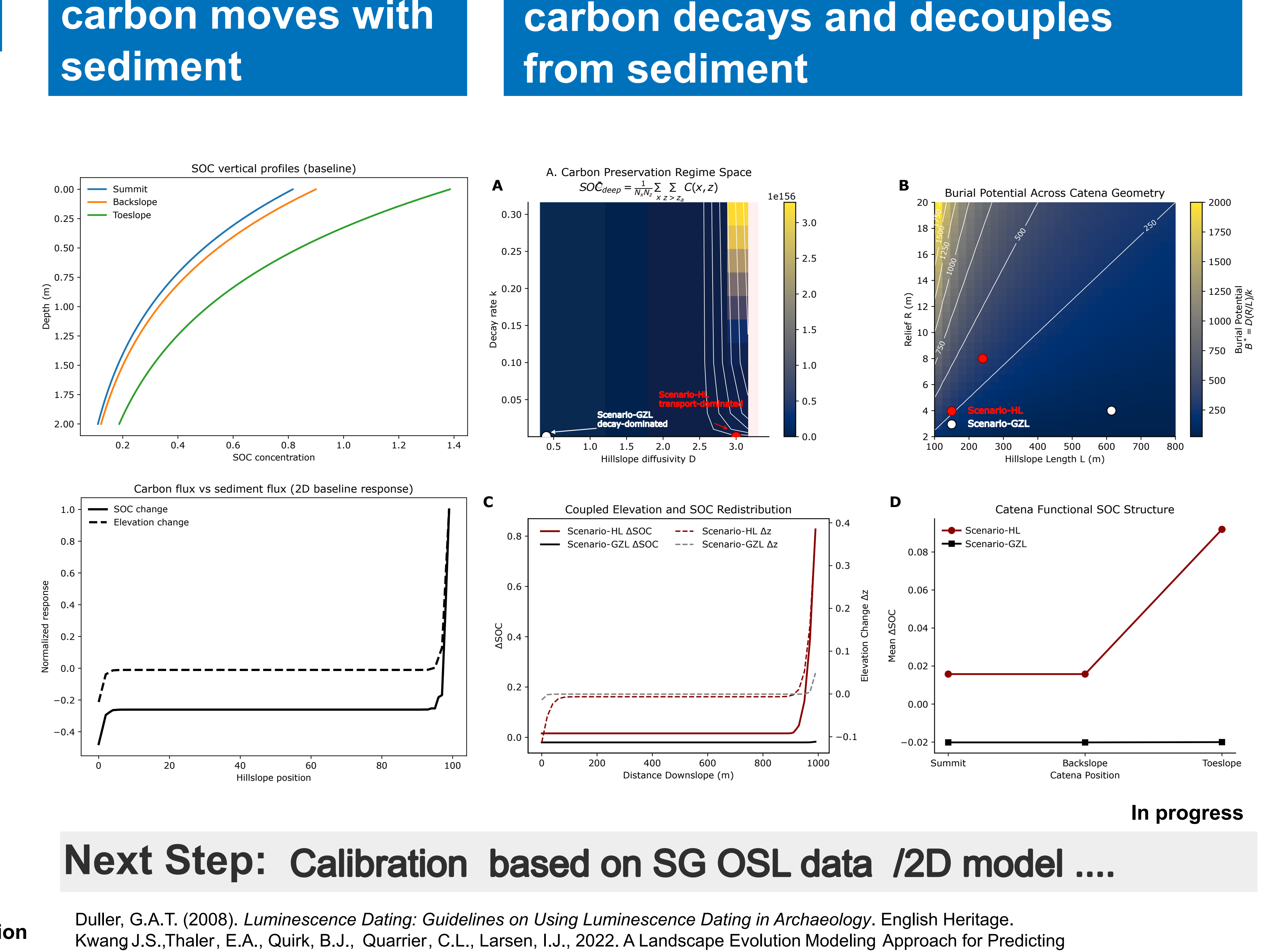


Heterogeneous bleaching of grains is governed by the competition between vertical mixing and lateral transport.

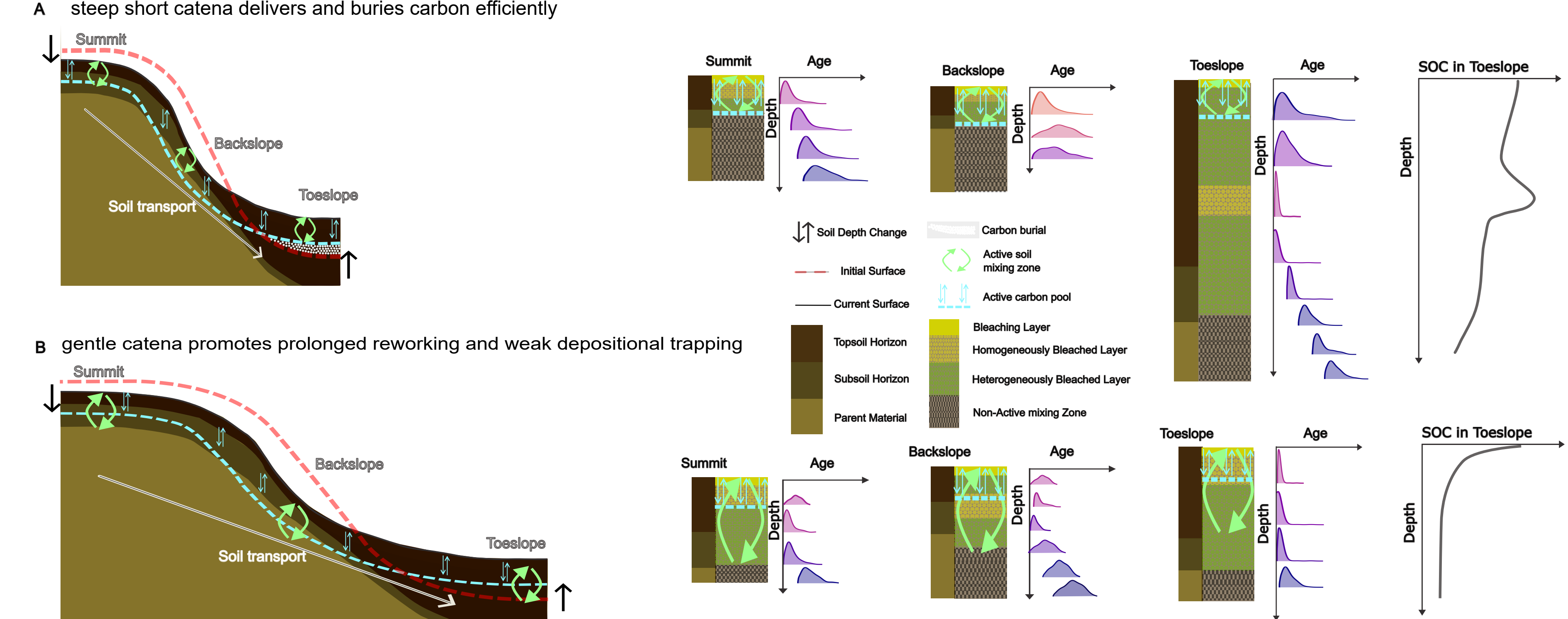


Passive transport: carbon moves with sediment

Reactive transport: carbon decays and decouples from sediment



Hypothesis: SOC decouples from sediment when vertical mixing and decay control carbon residence time more than lateral transport.



Carbon does not simply move with sediment! Carbon becomes decoupled from erosion when its loss depends on residence time rather than sediment movement.

Next Step: Calibration based on SG OSL data /2D model ...

Duller, G.A.T. (2008). *Luminescence Dating: Guidelines on Using Luminescence Dating in Archaeology*. English Heritage.
 Kwang J.S., Thaler, E.A., Quirk, B.J., Quarrier, C.L., Larsen, I.J., 2022. A Landscape Evolution Modeling Approach for Predicting Three-Dimensional Soil Organic Carbon Redistribution in Agricultural Landscapes. *J. Geophys. Res. Biogeosciences* 127, e2021JG006616. <https://doi.org/10.1029/2021JG006616>
 Thaler, E.A., Larsen, I.J., Yu, Q., 2021. The extent of soil loss across the US Corn Belt. *Proc. Natl. Acad. Sci.* 118, e1922375118. <https://doi.org/10.1073/pnas.1922375118>

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