Supplement to: Global analysis of in situ cosmogenic 26Al/10Be ratios in fluvial sediments indicates widespread sediment storage and burial during transport

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**Table S1:** AMS isotope ratio measurements, blanks, and all other data necessary for calculations of 26Al concentrations on archived samples from the University of Vermont.

**Table S2:** Sources, information, and basin statistics for all fluvial sediment samples in this compilation, including previously-published paired 26Al/10Be measurements and new 26Al measurements from archived samples with published 10Be measurements.

# Extended Methods

## Previously-published in situ cosmogenic 26Al/10Be data – Sources

Previously published 26Al/10Be measurements include older samples processed at UVM and samples that underwent Al/Be extraction and AMS measurements at various facilities around the world. We include samples processed at UVM prior to 2019 with 26Al concentrations measured at AMS facilities without a gas-filled magnet, thus resulting in larger uncertainties in measured 26Al concentrations. These older UVM samples are from southern Israel (n = 10; Clapp et al., 2000), New Mexico (n = 31; Clapp et al., 2001), Arizona (n = 6; Clapp et al., 2002), and Namibia (n = 9; Bierman personal communication).

## Morphometric and Climatological Basin Parameters – Detailed sources and procedures

All morphometric and climatological basin parameters were determined using ArcGIS Desktop v.10.7.1 and publicly available datasets. We followed the watershed delineation procedures outlined in Codilean et al. (2022) to create shapefiles for each basin upstream of sample collection points. The geoprocessing tools and settings for each parameter are specified below.

**Area –** Basin areas (km2) were calculated using the ‘Calculate Geometry’ tool with shapefiles projected into the Equal Earth projection (Šavrič et al., 2019).

**Elevation –** Mean elevation data were calculated for each basin using 1km, 500m, and (for all basins but those > 50,000 km2), 90m resolution elevation rasters and the ‘Zonal Statistics’ tool. The basin mean elevations used in figures and analyses were calculated by averaging the mean elevations from the 1km, 500m, and 90m rasters.

**Slope –** We calculated mean basin slope values for all basins using 1km, 500m, and (for all basins but those > 50,000 km2), 90m resolution elevation rasters. We then scaled the resulting mean slope values for each resolution to the values expected from a LiDAR digital elevation model at 2m resolution (using scaling methods outlined in Larsen et al. 2014) and took the mean of the resulting values as our basin mean slopes. Such scaling and averaging allows us to more confidently compare mean slope values across the spectrum of basin sizes, including extremely large basins. The raw data for all slope calculations is included in Table S2.

**Local Relief** – We used both a 500m (from HydroSheds, Lehner et al., 2008) and 250m (GMTED, Danielson and Gesch, 2011) resolution elevation raster in our analysis of basin local relief. For each raster, we calculated mean, standard deviation, and median local relief using a circular moving window with a 2km radii. We use local relief statistics from the 250m resolution in our analyses.

**Precipitation** – We used the WorldClim version 2.1 climate database (Fick and Hijmans, 2017) for precipitation data We specifically used the BIO12 (annual precipitation) variable in our analyses.

**Aridity** – We used the Global Aridity Index (Trabucco and Zomer, 2019), a 30 arc-second global raster using climate data from the 1970-2000 period. The aridity index is based on the ratio between precipitation and evapotranspiration. Aridity index values increase for more humid conditions and decrease for more arid conditions.

**Lithology –** All lithology data is from the GLiM database (Hartmann and Moosdorf, 2012). We identified the dominant lithology in each basin and calculated the percent of total basin area occupied by different lithologies. The GLiM vector data file was converted to a raster layer and then intersected with the basin polygons using the ‘Zonal Statistics’ tool. The lithological class with the largest count was taken as the dominant lithology. For each basin we also recorded the number of lithological units present – using the ‘Variety’ statistic.

**Tectonic Activity –** Weused plate strain rate data from (Kreemer et al., 2014) to gauge if a basin is located in a tectonically active or inactive (here called “post-orogenic”) region. We calculated mean, median, and standard deviations of strain rate for each basin using the Zonal Statistics tool. Basins with a mean strain rate less than 1 are considered post-orogenic, while values above are considered tectonically active.

**Flow Intermittence**  - We used the global river network dataset and predicted probability of intermittent flow data from (Messager et al., 2021) to calculate the predicted probability that river reaches in a basin cease to flow for at least one day per year on average somewhere along their length.

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