^{26}Al-^{10}Be isochron burial ages for Plio-Pleistocene river gravels of the Chesapeake Bay region, east –central United States

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We applied ^{26}Al - ^{10}Be isochron burial dating methods to subsurface river gravels on the eastern shore of the Chesapeake Bay, a major estuary of the US Atlantic coast. The Susquehanna River, the main river feeding Chesapeake Bay, repeatedly incised and back-filled the Chesapeake valley system during Plio-Pleistocene glacial-interglacial sea level fluctuations. With each cycle, this river system migrated southwest with the growth of the Delmarva Peninsula, the spit that forms the east side of the present bay. Thus, earlier cut-and-fill sequences were not effaced by later ones, and the subsurface stratigraphy of the Delmarva Peninsula preserves multiple stacked depositional units. Facies of these units include coarse sand and gravel, silty fine sand, clayey silt and silty clay, and peat in complex stratigraphic relationships. The entire Plio-Pleistocene sequence is incised into the underlying Miocene stratigraphy, leaving large relief on the Miocene surface. The timing of the Pleistocene sequence that records the last two glacial-interglacial cycles (< 120 ka) is well understood, largely via uranium-series, luminescence, and radiocarbon dating methods. Our objective is to improve understanding of the older, and much more extensive, part of the sequence that is largely dated by uncalibrated amino acid racemization methods at present by developing new means of chronostratigraphic correlation of sedimentary units. We show that ^{26}Al-^{10}Be burial isochron dating can potentially be used to accomplish this.

We collected subsurface river gravels of Susquehanna River provenance from a region of the west-central Delmarva Peninsula where the geologic framework is well known from a dense network of boreholes. Our samples are collected from boreholes. First, we sampled both individual clasts and sandy matrix from within sand and gravel deposits interpreted to be fluvial in origin; a burial age inferred from these samples dates the emplacement of the deposit. Second, we collected clasts from the basal portion of silt deposits that we interpret as remnant cutting agents from when paleovalleys were incised;

the burial age of these clasts provides information about the timing of incision events prior to silt deposition. We used an isochron method in which we measured ^{26}Al and ^{10}Be concentrations from several (≥3) clasts and grain size sand separates that were presumably derived from different settings within the Susquehanna River watershed, and thus subject to differing surface erosion rates, but were buried together so have identical post-burial nuclide production. Given these assumptions, ^{26}Al and ^{10}Be concentrations form a linear isochron in ^{26}Al - ^{10}Be space whose slope depends only on the duration of burial and not on post-depositional nuclide production.

We applied this approach at nine sites, all of which so far have at least three ^{26}Al-^{10}Be measurements associated with them. Individual isochrons display a large range in isotopic concentrations, with differences over a factor of 5 for both ^{26}Al and ^{10}Be within single isochrons. This range presumably stems from the large variability of erosion rates represented within the Susquehanna watershed and is optimal for the isochron method. Apparent isochron ages range from 2.33 ± 0.50 to 0.38 ± 0.10 Ma, in agreement with the presumed Plio-Pleistocene age of the sequence and the onset of Northern Hemisphere continental glaciation at 2.4 Ma. Isochron data and amino acid racemization data produced from the same borehole show stratigraphic consistency and indicate the potential for cross-calibration between methods. These data show promise for establishing age control for a long sequence of the Chesapeake Bay stratigraphy that has long lacked proxies for chronostratigraphic correlation.