Can we quantify chronostratigraphic uncertainty for timescale calibration?

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Abstract

The calibration of the Geologic Time Scale (GTS) requires the integration of ordinated events in Earth history (chronostratigraphy) with the determination of numerical age dates from specific stratigraphic levels (geochronometry). The calibration of chronostratigraphy by geochronometry gives us the geochronology that is the GTS. Determination of the numerical precision of a radioisotopic date is straightforward enough. The combination of the analytical, decay constant, and tracer calibration uncertainties provides the numerical +/- associated with the determined age date (i.e., the precision). Determination of the precision of correlation of a given stratigraphic position within a single outcrop to the global chronostratigraphic chart is another matter entirely. How can we determine the uncertainty in chronostratigraphic correlation, can we quantify this uncertainty, and why does this matter to the GTS? The final calibration of the GTS requires some form of statistical treatment, typically though a variety of regression analysis. Past versions of the GTS have relied upon a range of options including cubic splines, LOWESS, LOESS, or the increasingly common Bayesian techniques. When completing these final analyses, the uncertainty windows through which the regressions should pass must include both the temporal uncertainties associated with the numerical +/- from each geochronometric age date, AS WELL AS the chronostratigraphic uncertainty associated with the correlation of the position of each age date in its local stratigraphy. The parameterization and quantification of this second set of uncertainties has yet to be addressed in sufficient detail and we need community discussion and engagement to help to move this process forward.

Keywords: Time Scale, Calibration, Uncertainty, Chronostratigraphy, Geochronology

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