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High-precision U-Pb geochronology and the EARTHTIME Initiative: progress and potential

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Developments in U-Pb isotope dilution thermal ionisation mass-spectrometry (ID-TIMS) have resulted in a continued increase in the analytical precision with many laboratories now at or below 0.1%. This increase in precision, when applied to constraining the ages of ash beds from key stratigraphic, sections permits the integration of proxy records with unprecedented precision and accuracy, allowing for example, assessment of links between marine and terrestrial realms, synchroneity/ordering of events for intervals of interest and determination of rates of change.

During the first stage of this initiative, significant progress was made in forging links between geochronologists, paleontologists, and stratigraphers, identifying key intervals of Earth history for which higher resolution temporal constraints are essential, and discussing the merits of targeting intervals of biological and climatic change versus dating golden spikes. Additionally, EARTHTIME workshops (I and II) identified and addressed priority issues, such as interlaboratory bias and inter-decay scheme calibration, and proposed an aggressive plan to deal with them immediately. An example is the dating of standard minerals by numerous laboratories to assess the magnitude of interlaboratory bias. For U-Pb ID-TIMS geochronology, EARTHTIME tracer solutions were mixed and will be available to the community with the aim of effectively eliminating the largest source of interlaboratory bias (tracer calibration).

Progress must still be made on the intercalibration of high-precision U-Pb datasets with timescales based upon ^{40}K decay scheme and/or astronomical calibration to achieve the goal of seamless calibration of geological time. In addition to the ongoing U-Pb and ^{40}K (^{40}Ar-^{39}Ar) intercomparisons, high-precision datasets on suitable

samples constrained via astronomical calibration will permit direct comparison and integration of astronomical timescales with those based upon the measured ^{238}U and ^{235}U decay constants.

Ultimately, the level of community involvement will determine the degree to which the goals of this initiative are realised.