GTSnext: towards a next generation of the geological time scale over the last 100 millions years.

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The principal scientific objective of the Marie Curie Initial Trainings Network GTSnext is to establish the next generation standard Geological Time Scale with unprecedented accuracy, precision and resolution through integration and intercalibration of state-of-the-art numerical dating techniques. Such time scales underlie all fields in the Earth Sciences and their application will significantly contribute to a much enhanced understanding of Earth System evolution.

During the last decade deep marine successions were successfully employed to establish an astronomical tuning for the entire Neogene, as incorporated in the standard Geological Time Scale (ATNTS2004). In GTSnext we aim to fine-tune this Neogene time scale, before it can reliably be used to accurately determine phase relations between astronomical forcing and climate response in the Neogene and possibly also the Oligocene. Radio-isotopic dating of late Neogene ash layers offers excellent opportunities for gaining insight into isotope systematics via their independent dating by astronomical tuning. An example of this synergy is the development of astronomically calibrated standards for $^{40}Ar/^{39}Ar$ geochronology. The cross-calibration between the different methods might also yield information on the fundamental problem of potential residence times in U/Pb dating.

Extension of the astronomical time scale into the Paleogene seems limited to ~40 Ma due to the accuracy of the current astronomical solution. However, the 405 kyr eccentricity component is very stable permitting its use in time scale calibrations back to 250 Ma using only this frequency. This cycle is strong and well developed in Oligocene and even Eocene records. Phase relations between cyclic paleo-climate records and the 405 kyr eccentricity cycle are typically straightforward and unambiguous. Therefore, a first-order tuning to ~405 kyr eccentricity can only be revised by shifting the tuning with (multiples of) ~405 kyr. Isotopic age constraints of both U/Pb and $^{40}Ar/^{39}Ar$ will be used to anchor floating astronomical tunings, but absolute uncertainties in isotopic ages should be less than ± 200 kyr.

The Cretaceous is famous for its remarkable cyclic successions of marine pelagic sediments which bear the unmistakable imprint of astronomical climate forcing. As a consequence floating astrochronologies which are based on number of cycles have been developed for significant portions of the Cretaceous, covering a number of geological stages. Unfortunately, such floating time scales provide us only with the duration of stages but not with their age. However, due to significant improvements in numerical astronomical solutions for the Solar System and in the accuracy of radio-isotopic dating we will try to establish a tuned time scale for the Late Cretaceous. Classical cyclic sections in Europe (e.g. Sopelana, Spain) will be used for the tuning, but lack ash beds. Therefore, radio-isotopic age constraints necessary for the tuning will come from ash beds in the Western Interior Basin in North America.

Here we will present the first results of the GTSnext project.