The Earth System History Machine: A Dynamic Simulation of Plate Tectonics, Paleogeography, Paleoclimate and Paleobiogeography.

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Abstract

Since the time of Nicholas Steno, more than 350 years ago, field geologists, paleontologists, stratigraphers, and geophysicists have fastidiously and painstakingly described and mapped the surficial and buried layers of the Earth's crust, revealing its detailed and exquisite history. This story emerged slowly at first, then accelerated as Earth Historians were able to calibrate their correlations using absolute radiometric age-dating. Using this robust chronometric framework, we now can tell the exciting story of the Earth, in all of its interwoven tectonic, geographic, oceanographic, atmospheric, geochemical, climatic, and biologic complexity. During the last 30 years, Energy companies and national geological surveys have compiled 3D exploration databases and have built 3D stratigraphic models covering the globe. An immense amount of high-resolution, digital stratigraphic data are now in-hand. So what does the future hold? The task before us is two-fold: first, a new Earth System History "Library of Alexandria" must be built from this great volume of digital Earth System History data to preserve it for future generations and, more importantly, to create a comprehensive, coherent and authoritative digital data source for the emerging artificial intelligence systems (e.g., GPT5). The second task, though daunting, is to use this Earth System History database, along with important geophysical data bases, to build an "Earth System History Machine". This Earth System History Machine will dynamically simulate the plate tectonic, paleogeographic, sedimentologic, paleoceanographic, geochemical, paleoclimatic evolution of the Earth since its beginnings, through to the present, and forward into the future Anthropocene. Numerous researchers, who span the globe, are now actively working towards this lofty goal They include researchers and students at the PALEOMAP Project (Northwestern University), EarthByte (University of Sydney), CEED (Norway), University of Geneva, University of Chicago, Leeds University, Chronosphere Project (Erlangen), University of Bristol, Texas A&M University, NMNH, DDE Project, Purdue University, Chinese Academy of Sciences, Peking University, University of Geosciences (Wuhan), Nanjing University, Paleobiology Database, Macrostrat (University of Wisconsin), Utrecht University, University of Western Australia, CNRS, ETH, University of Lisbon, and others.

Keywords: Earth system history, plate tectonics, paleogeography, paleoclimate, paleobiogeography

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