Seminars of geology

Department of Earth Sciences - Torino

Contact: geoseminar.dst@unito.it

Wednesday 10 December 2025

ONLINE SEMINAR via webex at this LINK

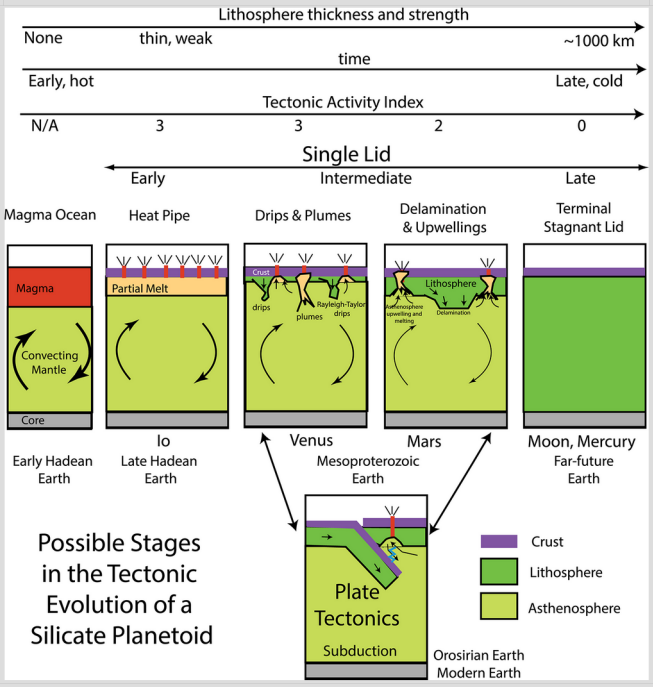
5pm (Rome time)

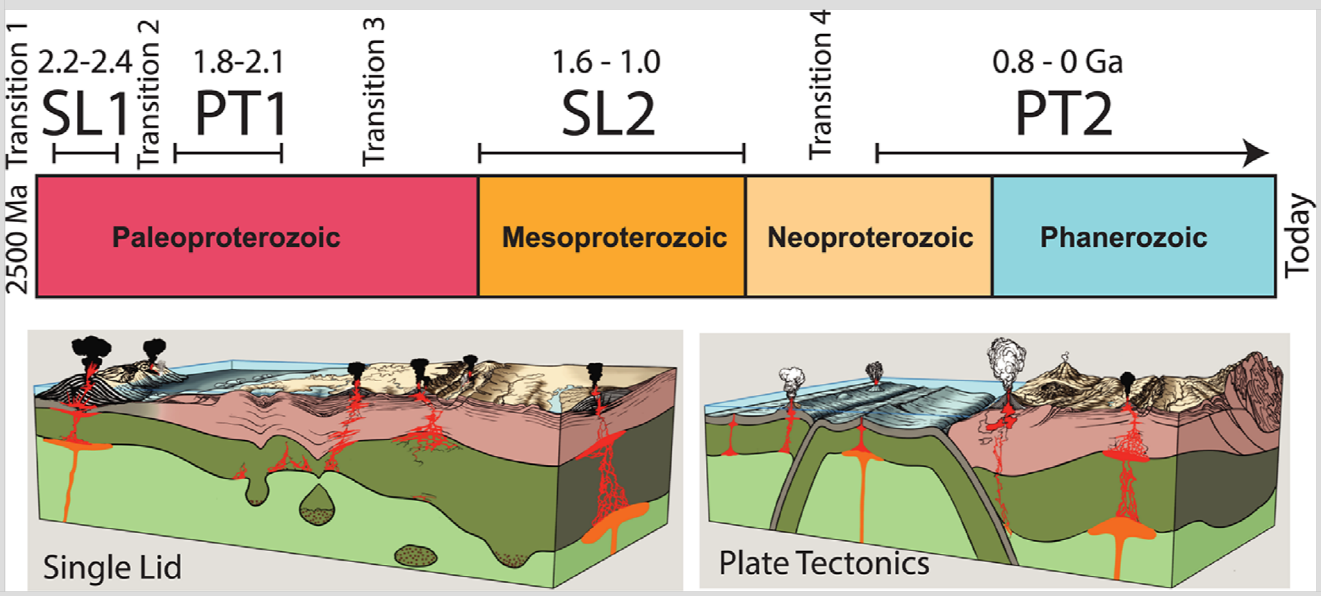
The Evolution of Plate Tectonics over the past 2.5 Billion Years

Robert J. Stern

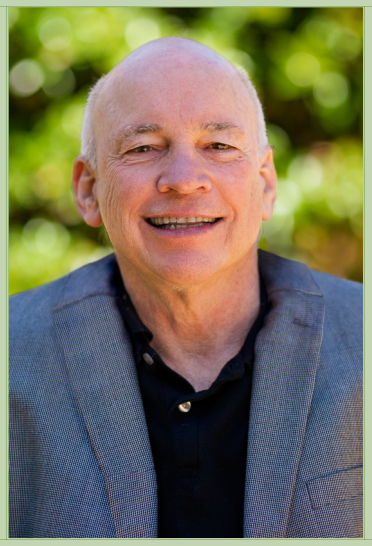
University of Texas, Dallas

This talk is based on Stern (2024), which re-interprets the past 2.5 billion years of Earth's tectonic history as four alternating episodes when plate tectonics dominated and when it did not. Solar System exploration over the past 50 years reveals that 75% of the four actively convecting silicate bodies (Venus, Earth, Mars, and Io) do not have plate tectonics. Instead, their deformed and magmatically active lithospheres are better characterized as coherent, if deformed, single lids. I identified geologic indicators of plate tectonic regimes and single-lid tectonic regimes, used published compilations of these, and worked backward in time to 2.5 Ga. This analysis reveals four distinct tectonic episodes, two each of plate tectonics (PT) and single-lid (SL) tectonics. The youngest is the current episode of plate tectonics (PT2), which began at ca. 800 Ma. PT2 was preceded by an ~600-m.y.-long episode of single-lid tectonics during the Mesoproterozoic (SL2). SL2 was preceded by an ~300-m.y.-long episode of plate tectonics in mid-Paleoproterozoic time (PT1). The oldest post-2.5 Ga tectonic episode was an enigmatic ~200-m.y.-long interval of single-lid tectonics in early Paleoproterozoic time (SL1). Each episode is separated from earlier and later episodes by transitional periods lasting 100–200 m.y. This reinterpretation of Earth's post-2.5 Ga tectonic history helps to explain why Earth's mantle is warmer than it would be if it had cooled as rapidly as it is cooling today—that is, if plate tectonics operated continuously during this time. It also moots the question of "*When did plate tectonics start?*" and suggests that a better questions, "*How far back in time can we confidently reconstruct Earth's tectonic history?*" The reframed question provides new research opportunities and insights into mineralization, climate, and biologic evolution, and opens the door to a better understanding of earlier tectonic styles, especially in the Late Archean.





The Speaker



Robert J. Stern is Professor of Geosciences at the University of Texas at Dallas. He received his PhD at the Scripps Institute of Oceanography at UC San Diego. He carried out post-doctoral studies at the Department of Terrestrial Magnetism, Carnegie Institution of Washington, and has been a visiting scholar at Stanford U., Caltech, and ETH Zurich. Today, his research focuses on understanding how subduction zones and convergent margin magmatic systems form and evolve, the geotectonic evolution of NE Africa, Arabia, and Iran, and the evolution of Plate Tectonics. He is currently helping to develop the emerging multidisciplinary field of Biogeodynamics, which investigates the coupling between geodynamic processes, atmosphere, ocean, landscape, climate and the evolution of life. More information can be found on his Google Scholar profile and on his Wikipedia page. He is director of the UTD Global and Magmatic Laboratory and UTDGeoscience Studios, co-director of the Permian Basin Research Lab, and co-director of the UTD Geosciences Micro-Imaging Lab and Meteorite Education and Research Lab