Thermal maturity of the accretionary wedge

Utsav Mannu¹, David Fernández-Blanco²,³, Ayumu Miyakawa⁴, Taras Gerya⁵, and Masataka Kinoshita⁶
¹Indian Institute of Science Education and Research, Department of Earth and Climate Science, India
(utsav@iiserpune.ac.in)
²Université de Paris, Institut de physique du globe de Paris, CNRS, F-75005 Paris;
³Basins Research Group (BRG), Department of Earth Science & Engineering, Imperial College London;
⁴Geological Survey of Japan, AIST
⁵Institute of Geophysics, ETHZ Zurich
⁶Earthquake and Volcano Information, Earthquake Research Institute, Tokyo-U;

Records of thermal maturities in boreholes have led to a better understanding of the formation of geological structures, especially the duration of thrusting during the evolution of accretionary wedges. The temporal extent of thrusting is controlled by a host of factors such as the nature of sedimentation, the topography of the incoming plate and so on. As a result, estimating the peak heating through the thermal maturity of organic material can help elucidate which mechanism has played a prominent role in wedge evolution. However, the thermal maturity value expressed as the distribution of vitrinite reflectance is the combined effect of two factors: the geothermal gradient and the time the sediments were exposed to different temperatures. Thus, the distribution of vitrinite reflectance in accretionary wedges does not necessarily reveal the deformational pathway of individual thrusts. Moreover, since the conductivity of the sediments close to the surface (<10 km) is most accessible in borehole data and predominantly controlled by porosity, models of accretionary wedge simulating thermal maturity ought to incorporate the impact of porosity on thermal conductivity. Additionally, phase transitions of the sediments in the wedge, such as smectite-illite transition and the formation of zeolite facies, that lead to increased thermal conductivity and internal angle of friction for sediments at structurally deeper locations within the wedge, must be accounted for in modeling studies. Therefore, we use a 2D thermomechanical model of subduction with empirical porosity values from the Nankai subduction margin and incorporate the effect of phase transitions to simulate the formation of the accretionary wedge under several sedimentary conditions and track the evolution of the vitrinite reflectance. As a result, we gain a holistic picture of deformation in accretionary wedges exploring different scenarios using geodynamic modeling alongside field data.