Research report for ERI Visit
Xiang Gao

During my 6-month visit in ERI, I worked with Dr. Makoto Yamano on the role of temperature and fluids on subduction zone earthquakes. We developed thermal models with fluids circulation in the subducting oceanic crust, similar to that of Spinelli and Wang (2008) and Kawada et al. (2014), to explain the high heat flow anomalies observed off Muroto in the Nankai Trough. However, observed heat flow has along-strike variations in the Nankai Trough, which indicates that this vigorous fluids circulation in the subducting oceanic crust may not pervasively exist along-strike. By combining the seismic observations, we found that the variations of observed heat flow have good correlation with the structure and geometry of the subducting slab. Both the rough basement topography and the along-strike bending of the subducting slab around Muroto area could make high permeability in the oceanic crust and then facilitate heat transfer from deep to shallow through fluids circulation. The resultant variations of the fault temperature can potentially change the rupture range of large earthquakes. This hypothesis also has indications on explanation of heat flow anomalies in other subduction zones. Parts of this work will be presented at the 2016 AGU fall meeting with the abstract number T31C-2917.

I also kept on exploring how thermo-petrologically controlled fault zone rheology affects the episodic tremor and slip (ETS) around the mantle wedge corner (MWC) in warm subduction zones. High temperatures cause frictional behavior (corresponding to the seismogenic zone) to terminate at a depth much shallower than the MWC. Around the MWC, elevated pore-fluid pressures can promote fault slip behavior to return to be frictional (corresponding to episodic tremor and slip) in an isolated depth range. Between the two frictional segments, the slip behavior exhibits semi-frictional and/or viscous, which may facilitate long-term slow slip or stable creep. The new rheological model puts a wide range of unexplained characteristics of ETS into geological context: its separation from the seismogenic zone, its correlation with the MWC, and its abundance in warm subduction zones. I gave four talks related to this work at the 2016 JpGU meeting, Kobe University, ERI (slow earthquakes workshop and OHRC seminar). In addition, I gave another two talks on strength of the megathrust fault and its relation to large subduction zone earthquakes at ERI (the 948th Danwakai (program)) and JAMSTEC. I thank the colleagues in and out of ERI for the helpful comments and discussion.

I sincerely wish to thank all staff of ERI for making such a valuable and memorable visit. In particular, I would like to deeply thank my host, Dr. Makoto Yamano, for his generosity, inspiration, and sharing experience and ideas during my visit. I also wish to deeply thank Ms. Yuko Yamada and other staff of International Office for their generous support in every step of my visit.