*Collaborative Research: Volatiles (*H2O *and* CO2*) in Mariana and Izu Arc Magmas (w/ Grove, Stolper, Newman) OCE-0001897 9/00 - 8/05*.

This project supported the 2003 Ph.D. thesis of Katherine Kelley (now in a faculty position at the Univ. of Rhode Island), partially supported the training of two Boston University female Ph.D. students (Mindy Zimmer and Jennifer Wade), as well as an undergraduate (Mike Hamilton) who was a Masters candidate at Northern Arizona. Below are the different sub-projects and products supported by the grant.

1) Volatile measurements in melt inclusions from Marianas tephra.

The primary data-collection effort of this project was in the analysis of volatile species (H2O, CO2, S, Cl, F) in olivine-hosted melt inclusions from basaltic tephra from the Marianas islands Pagan, Guguan, Sarigan and Agrigan. Samples were generously donated by Fred Anderson, at the University of Chicago, following his ground-breaking work in the 1980's. Inclusions were prepared at Boston University, analyzed by FTIR at Caltech, and SIMS ion microprobe at the Carnegie Institution of Washington. This work formed a major component of the PhD thesis of Katherine Kelley, and work has been reported at several AGU meetings (Kelley et al., 2001, 2002, 2003), and in a paper in preparation (Kelley et al., 2007).

Samples: Table is coming: Marianas MI samples

Data: Table is attached: Mar-MI-KK-Oct07.xls. Proprietary hold.

References:

Kelley, K.A., Plank, T., Newman, S., Stolper, E. Grove, T.L., Parman, S. and Hauri, E. Mantle melting as a function of water content at subduction zones. II: Arcs. Manuscript in preparation for JGR, 2007.

Kelley, K.A., Plank, T., Newman, S., Stolper, E. Grove, T.L., Parman, S. and Hauri, E. (2003) Mantle Melting as a Function of Water Content in Arcs. Eos Trans. AGU, 84(46), Fall Meet. Suppl., Abstract V41D-06, 2003.

Kelley, K.A., Newman, S., Plank, T., Grove, T.L. and Parman, S. (2002) Subducted Fluid and Sediment Compositions Preserved in Mariana Arc Melt Inclusions. Eos Trans. AGU, 83(47), Fall Meet. Suppl., Abstract V21C-10, 2002

Kelley, K.A., Newman, S., Plank, T., Grove, T.L. and Parman, S. (2001) Melt inclusions in Mariana arc lavas: Volatiles, trace elements and linkages to subducted components. Eos Trans AGU, 82 (47), Fall Meet. Suppl., Abstract T32D-07.

2. Modeling the wet mantle melting process

As we began to interpret the arc volatile data, it became clear that we needed a better framework in which to understand how magmas are formed in wet regions of the mantle. Thus, another major activity on this project was to explore wet melting in back-arc basins, where the upper plate and mantle flow are better understood than at arcs. This resulted in a major work [*Kelley et al*., 2006]. This work finds linear relationships between the amount of water and the degree of melting in the mantle beneath back-arcs and arcs, in a manner completely different than at ridges. This work is also the first to show a relationship between the water content of arc and back-arc magmas, and the distance to the trench. Another paper integrates back-arc petrologic and seismic observations, finding mantle temperature as a major control on mean properties [*Wiens et al.*, 2006].

Samples: No new samples

Data: Used existing data compiled from PetDB, and other sources

References:

Kelley, K.A., Plank, T., Newman, S., Stolper, E. Grove, T.L. and Hauri, E. (2006) Mantle melting as a function of water content at subduction zones. I: Back-arc Basins. J. Geophysical Research, 111: B09208.

Wiens, D.A., Kelley, K. and Plank, T. (2006) Mantle temperature variations beneath back-arc spreading centers inferred from seismology, petrology and bathymetry. *Earth and Planetary Science Letters*, 248: 30-42.

3. The 2004 Eruption of Anatahan

In the middle of this project, Anatahan volcano in the Marianas erupted for the first time historically. MARGINS supported a rapid response field campaign to sample both old and new volcanics from the island of Anatahan (see Fisher, Hilton, and Hauri project). Our grant supported the major and trace element analysis of this material, which revealed a type example of magma evolution through simple crystal fractionation from basalt to dacite, with no geochemical evidence of crustal interaction. Our work was published in a special volume of the Journal of Volcanology and Geothermal Research (Wade et al., 2005).

Samples: Table is coming: Anatahan samples (need to add lat and long)

Data: these are already in Georoc, where all 6 files can be downloaded

References:
Wade, JA, T Plank, RJ. Stern, DL. Tollstrup, JB. Gill, JC.O'Leary, J Eiler, R B. Moore, JD Woodhead, F Trusdell, TP. Fischer, and DR. Hilton (2005) The May 2003 eruption of Anatahan volcano, Mariana Islands: geochemical evolution of a silicic island arc volcano. *J. Volcan. Geotherm. Res.*, v. 146: 139-170.

4. Oceanic input to the Izu-Mariana subduction zone

This project, in combination with funding from the Joint Oceanographic Institutions, supported the geochemical analysis of the oldest oceanic crust in the Pacific outboard of the Marianas trench, and sediments subducting into the Izu trench, as sampled during ODP Leg 185 [Plank et al., 2000; Ludden et al., 2006]. From this work, we developed geochemical reference sections for altered Pacific oceanic [*Kelley et al*., 2003] and Izu trench sediments [Plank et al., 2007], and presented a U-Th-Pb mass balance across the Marianas subduction zone [Kelley et al., 2005].

Samples: Table is coming: samples from ODP 185 and 129

Data: I suspect these are already in Georoc or SedDB, need to check.

References:
Plank, T., Ludden, J.N., Escutia, C., et al. (2000) Proc. ODP, Init. Repts., 185 [Online]. <http://www-odp.tamu.edu/publications/185_IR/185ir.htm>
Ludden, J., Plank, T. Larson, R. and Escutia, C. (2006) ODP Leg 185: Sampling the oldest crust in the ocean basins to understand Earth's geodynamic and geochemical fluxes. Leg Synthesis. Proc. ODP, Sci. Res. [Online]. <http://www-odp.tamu.edu/publications/185_IR/185ir.htm>.
Plank, T., Kelley, K.A., Murray, R.W., and Quintin-Stern L. (2007) Chemical composition of sediment subducting at the Izu-Bonin trench. *Geochem. Geophys. Geosyst*, v. 8/4, Q04I16, doi:10.1029/2006GC001444, 16 pp.
Kelley, K.A., Plank, T., Ludden, J.N. and H. Staudigel (2003) The composition of altered oceanic crust at ODP sites 801 and 1149. *Geochem. Geophys. Geosyst.*. 4 (6), doi: 10.1029/2002GC000435.
Kelley, K.A., Plank T., ÝFarr, L., Ludden, J. and Staudigel, H. (2005) Subduction cycling of U, Th and Pb. *Earth & Planetary Science Letters*, 234: 369-383.