Geochemical Products of Subduction

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What are the geochemical products of subduction?

- Fluids
  - aqueous, supercritical, brines, volcanic gases
- Melts
  - Slab melts, mantle melts, crustal melts
Fluid production in the slab

Tianshan blueschist
Beinlich et al. 2010

Hacker 2008
Partial melting of eclogite

Migmatized eclogite
Erzgebirge, Germany

LeVay et al. submitted

Hacker 2006
Products of Subduction

• Forearc fluids
• Arc lithosphere
• Ash, weathering products, and sediments
• Atmospheric volatiles
• Mantle domains
• What are the geochemical characteristics of the materials that subduction returns to the Earth’s mantle, and how are these related to the development of long-term mantle heterogeneity?

Mantle reservoirs

Hofmann 1997
Evidence for sediment recycling

Jackson 2007
Cl isotope evidence for subducted material in the mantle

John et al. 2010
Boron isotope fractionation and recycling

Dehydration modeling

Tourmaline zoning

Marschall et al. 2007
Bebout and Nakamura 2003
Boron isotope fractionation and recycling

Azores OIB

Azores Plume

~1500 km

Turner et al. 2007

Montelli et al. 2004
• What are the rates and processes of arc crust growth and differentiation and how is arc crust transformed to continental crust?
Continental Arc Magmas - upper and lower crust contributions

Maipo (Southern Volcanic Zone)

- what is the nature of continental arc crust at depth?

Feineman, Sruoga, and Drew, ongoing study
Low velocity zones in the lower crust

GILBERT ET AL 2006
Continental arc crust

Valle Fertil, Argentina (Famatinian Arc)

Otamendi et al. 2009
Formation of intermediate arc magmas in the mid/lower crust

Otamendi et al. 2009
Timescales of differentiation and deep crustal melting

Annen et al. 2006
Continental crust formation by lower crust delamination

Zegers and van Keken 2001
TTG formation in lower crust
Fiordland, New Zealand

Stevenson et al. 2005
Mass balance issues: Volcanic fluxes

- how well do erupted volumes represent mass transfer from mantle to crust?
Mass balance issues:

Hidden reservoirs

Study of 19 eclogite localities reveals
a) little HFSE fractionation in eclogite relative to MORB;
b) lack of superchondritic Nb/Ta reservoir

Barth et al 2000

Rudnick et al 2000

Schmidt et al 2009
What role does weathering and erosion play in the compositional and dynamic evolution of volcanoes and volcanic arcs?

Lee et al. 2008
New directions

- How can direct observations of exhumed arc components inform our study of active arcs?
New directions

• Focus on integrated, managed datasets for selected suites of samples, eg:
  – Petrography
  – Major elements
  – Trace elements
  – Radiogenic isotopes
  – Stable / non-traditional isotopes
  – Mineral compositions and zoning
### Sample / Data Management

**Field area:**

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<th>description</th>
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**Laboratory:**

**Contact person:**

**Analytical method:**

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Overarching Question

• What is the mass and composition of subduction zone products we can’t observe at the surface?
  – “New” subduction tracers (i.e. non-traditional light stable isotopes) in OIB
  – Exhumed margins
  – Seismic studies
Implementation

• Look beyond “focus sites” to put emphasis on coordinated efforts, comprehensive data sets, and organized data management

• Postmortem assessment - study exhumed components of “dead” arcs to illuminate processes deep within active arcs