Announcements

• No lecture on Friday
• Lab final begins at 1 PM
• Today’s agenda:
  • Lecture/Demo
• Go through field trip pics
  • Call for pizza
• Lab review
• Lecture Review
• Make poster
Continental Alkaline Magmatism.
The East African Rift

What else have we found in the East African Rift?

Figure 19-9. Hypothetical cross sections (same vertical and horizontal scales) showing a proposed model for the progressive development of the East African Rift System. a. Pre-rift stage, in which an asthenospheric mantle diapir rises (forcefully or passively) into the lithosphere. Decompression melting (cross-hatch-green indicate areas undergoing partial melting) produces variably alkaline melts. Some partial melting of the metasomatized sub-continental lithospheric mantle (SCLM) may also occur. Reversed decollements ($D_1$) provide room for the diapir. b. Rift stage: development of continental rifting, eruption of alkaline magmas (red) mostly from a deep asthenospheric source. Rise of hot asthenosphere induces some crustal anatexis. Rift valleys accumulate volcanics and volcaniclastic material. c. Afar stage, in which asthenospheric ascent reaches crustal levels. This is transitional to the development of oceanic crust. Successively higher reversed decollements ($D_2$ and $D_3$) accommodate space for the rising diapir.

Continental Alkaline Magmatism. Carbonatites

Continental Alkaline Magmatism. Carbonatites

**Figure 19-12.** Initial $^{143}\text{Nd}/^{144}\text{Nd}$ vs. $^{87}\text{Sr}/^{86}\text{Sr}$ diagrams for young carbonatites (dark shaded), and the East African Carbonatite Line (EACL), plus the HIMU and EMI mantle reservoirs. From Bell and Blenkinsop (1987, *Geology*, 15, 99-102), (1989, in K. Bell (ed.), *Carbonatites: Genesis and Evolution*. Unwin Hyman, London, pp. 278-300). Also included are the data for Oldoinyo Lengai natrocarbonatites and alkali silicate rocks (from Bell and Dawson, 1995, in Bell, K. and J. Keller (eds.), (1995). *Carbonatite Volcanism: Oldoinyo Lengai and the Petrogenesis of Natrocarbonatites*. Springer-Verlag, Berlin, pp. 100-112). MORB values and the Mantle Array are from Figure 10-15. Winter (2001) An Introduction to Igneous and Metamorphic Petrology. Prentice Hall.
Immiscible liquids: Demo

The diagram illustrates the phase behavior of immiscible liquids as a function of temperature (T) and composition of silica (SiO₂). The system consists of different phases such as liquid, two liquids, and solid phases including forsterite, enstatite, cristobalite, and tridymite. The diagram shows the critical point and phase boundaries, indicating the conditions under which two distinct liquid phases are stable. Cooling from a single liquid phase (X) results in the formation of two liquid phases (Water and Oil) as the composition and temperature change.
Figure 19-15. Silicate-carbonate liquid immiscibility in the system \( \text{Na}_2\text{O-CaO-SiO}_2-\text{Al}_2\text{O}_3-\text{CO}_2 \) (modified by Freestone and Hamilton, 1980, to incorporate \( \text{K}_2\text{O, MgO, FeO, and TiO}_2 \)). The system is projected from \( \text{CO}_2 \) for \( \text{CO}_2 \)-saturated conditions. The dark shaded liquids enclose the miscibility gap of Kjærsgaard and Hamilton (1988, 1989) at 0.5 GPa, that extends to the alkali-free side (A-A). The lighter shaded liquids enclose the smaller gap (B) of Lee and Wyllie (1994) at 2.5 GPa. C-C is the revised gap of Kjærsgaard and Hamilton. Dashed tie-lines connect some of the conjugate silicate-carbonate liquid pairs found to coexist in the system. After Lee and Wyllie (1996) *International Geology Review*, 36, 797-819. Winter (2001) *An Introduction to Igneous and Metamorphic Petrology*. Prentice Hall.
Continental Alkaline Magmatism.

Carbonatites

Ol Doinyo Lengai, Tanzania

Eruption temperature: 491-544 °C

SI GVP
Chapter 19: Continental Alkaline Magmatism.
Kimberlites

Figure 19-19. Model of an idealized kimberlite system, illustrating the hypabyssal dike-sill complex leading to a diatreme and tuff ring explosive crater. This model is not to scale, as the diatreme portion is expanded to illustrate it better. From Mitchell (1986) Kimberlites: Mineralogy, Geochemistry, and Petrology. Plenum. New York. Winter (2001) An Introduction to Igneous and Metamorphic Petrology. Prentice Hall.
Figure 19-20b. Hypothetical cross section of an Archean craton with an extinct ancient mobile belt (once associated with subduction) and a young rift. The low cratonal geotherm causes the graphite-diamond transition to rise in the central portion. Lithospheric diamonds therefore occur only in the peridotites and eclogites of the deep cratonic root, where they are then incorporated by rising magmas (mostly kimberlitic-“K”). Lithospheric orangeites (“O”) and some lamproites (“L”) may also scavenge diamonds. Melilites (“M”) are generated by more extensive partial melting of the asthenosphere. Depending on the depth of segregation they may contain diamonds. Nephelinites (“N”) and associated carbonatites develop from extensive partial melting at shallow depths in rift areas. After Mitchell (1995) *Kimberlites, Orangeites, and Related Rocks*. Plenum. New York. Winter (2001) *An Introduction to Igneous and Metamorphic Petrology*. Prentice Hall.