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?

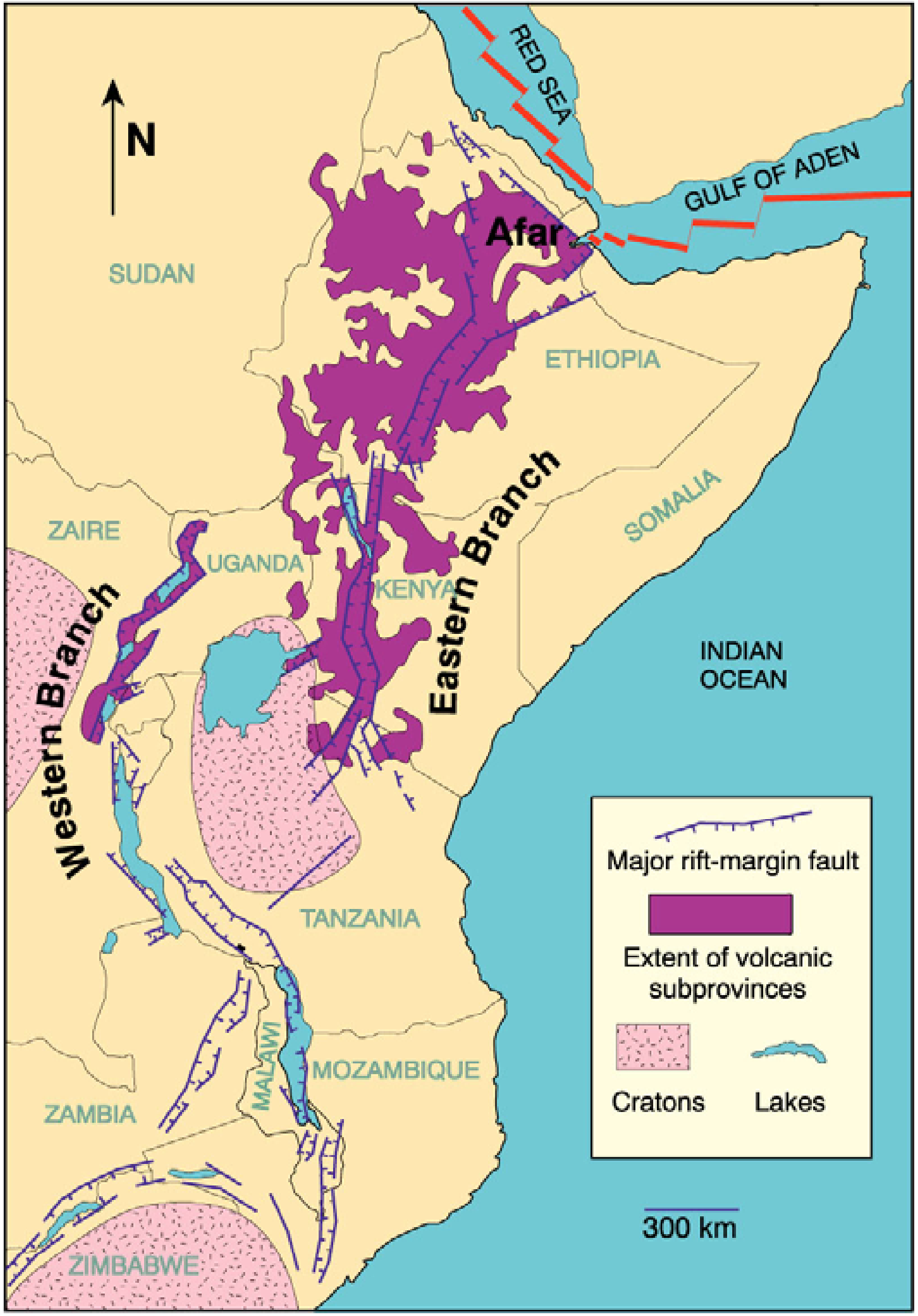


Figure 19-2. Map of the East African Rift system (after Kampunzu and Mohr, 1991), Magmatic evolution and petrogenesis in the East African Rift system. In A. B. Kampunzu and R. T. Lubala (eds.), *Magmatism in Extensional Settings, the Phanerozoic African Plate*. Springer-Verlag, Berlin, pp. 85-136. Winter (2001) An Introduction to Igneous and Metamorphic Petrology. Prentice Hall.

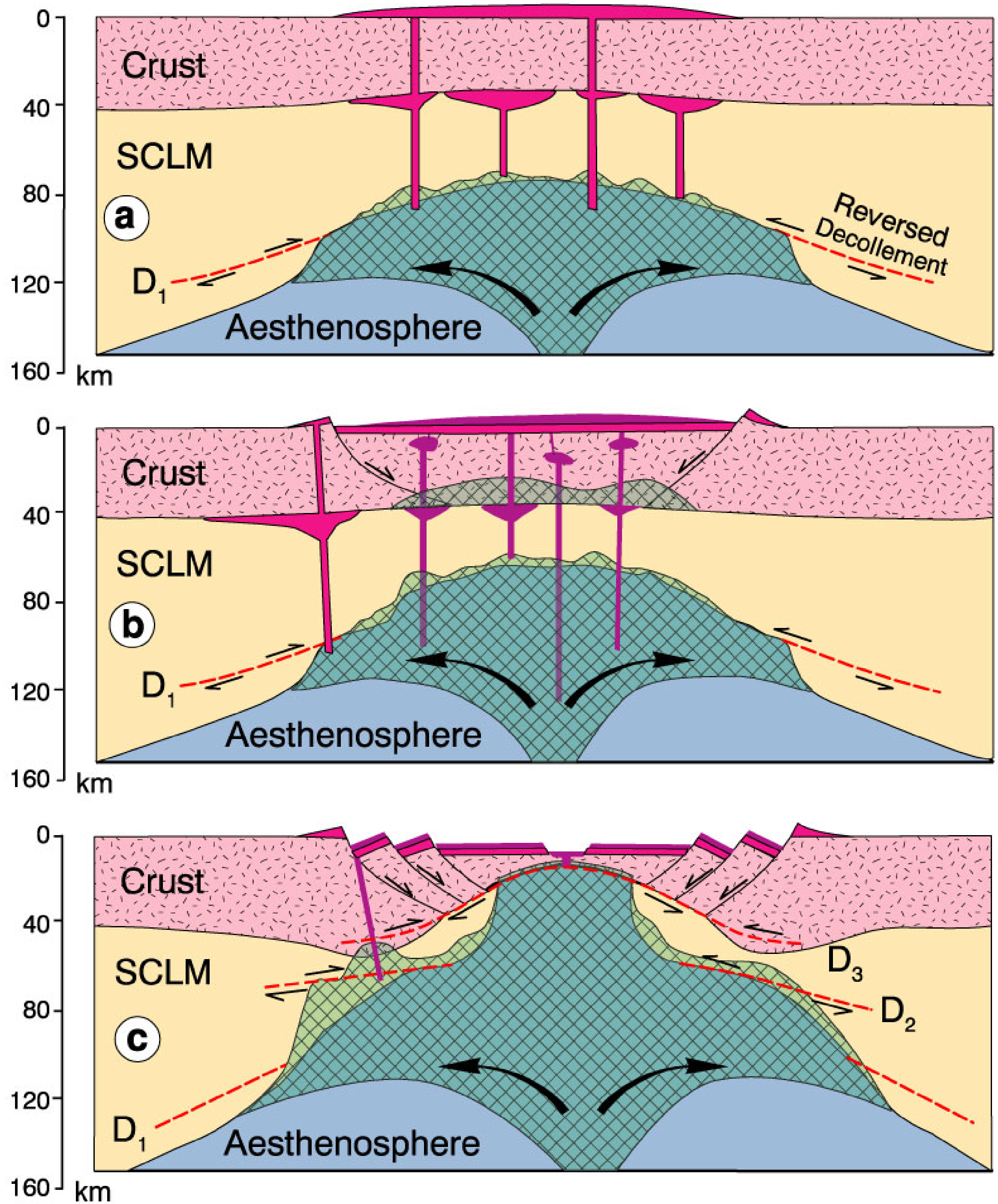


Figure 19-9. **Hypothetical cross sections (same vertical and horizontal scales) showing a proposed model for the progressive development of the East African Rift System. a. Pre-rift stage, in which an asthenospheric mantle diapir rises (forcefully or passively) into the lithosphere. Decompression melting (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. After Kampunzu and Mohr (1991), Magmatic evolution and petrogenesis in the East African Rift system. In A. B. Kampunzu and R. T. Lubala (eds.), *Magmatism in Extensional Settings, the Phanerozoic African Plate*. Springer-Verlag, Berlin, pp. 85-136 and P. Mohr (personal communication). Winter (2001) An Introduction to Igneous and Metamorphic Petrology. Prentice Hall.**

Continental Alkaline Magmatism. Carbonatites

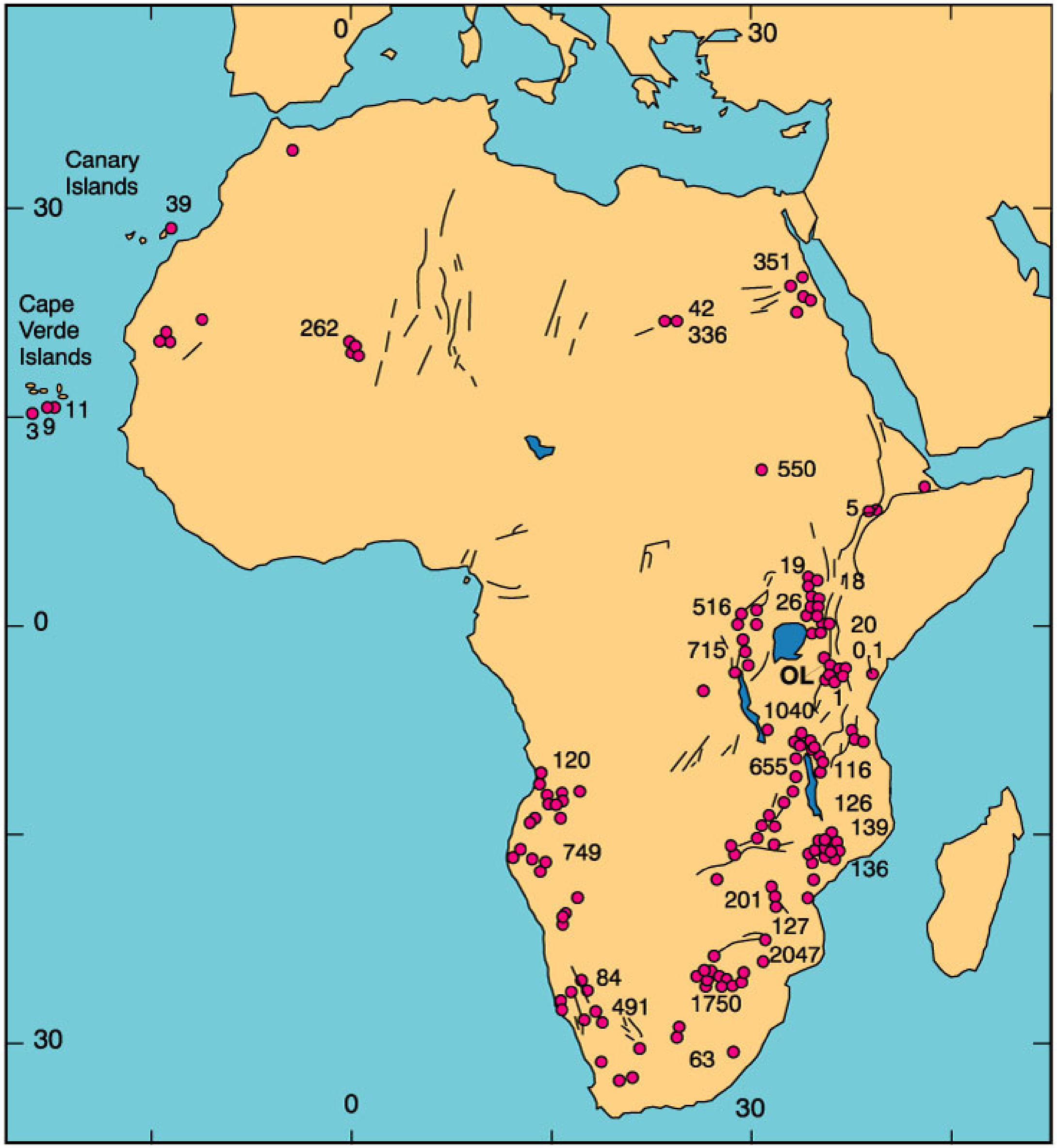


Figure 19-10. African carbonatite occurrences and approximate ages in Ma. OL = Oldoinyo Lengai natrocarbonatite volcano. After Woolley (1989) The spatial and temporal distribution of carbonatites. In K. Bell (ed.), *Carbonatites: Genesis and Evolution*. Unwin Hyman, London, pp. 15-37. Winter (2001) An Introduction to Igneous and Metamorphic Petrology. Prentice Hall.

Continental Alkaline Magmatism. Carbonatites

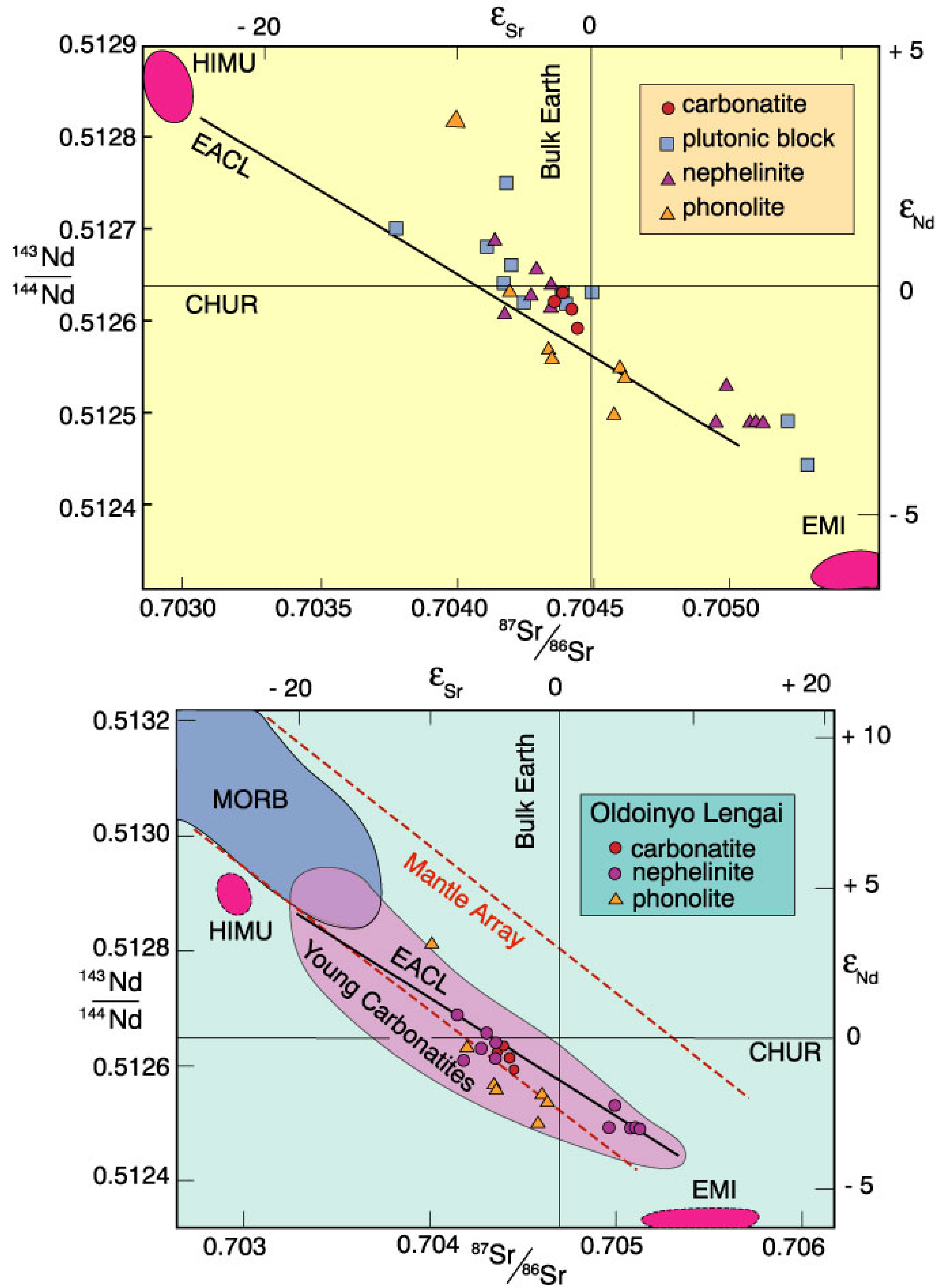
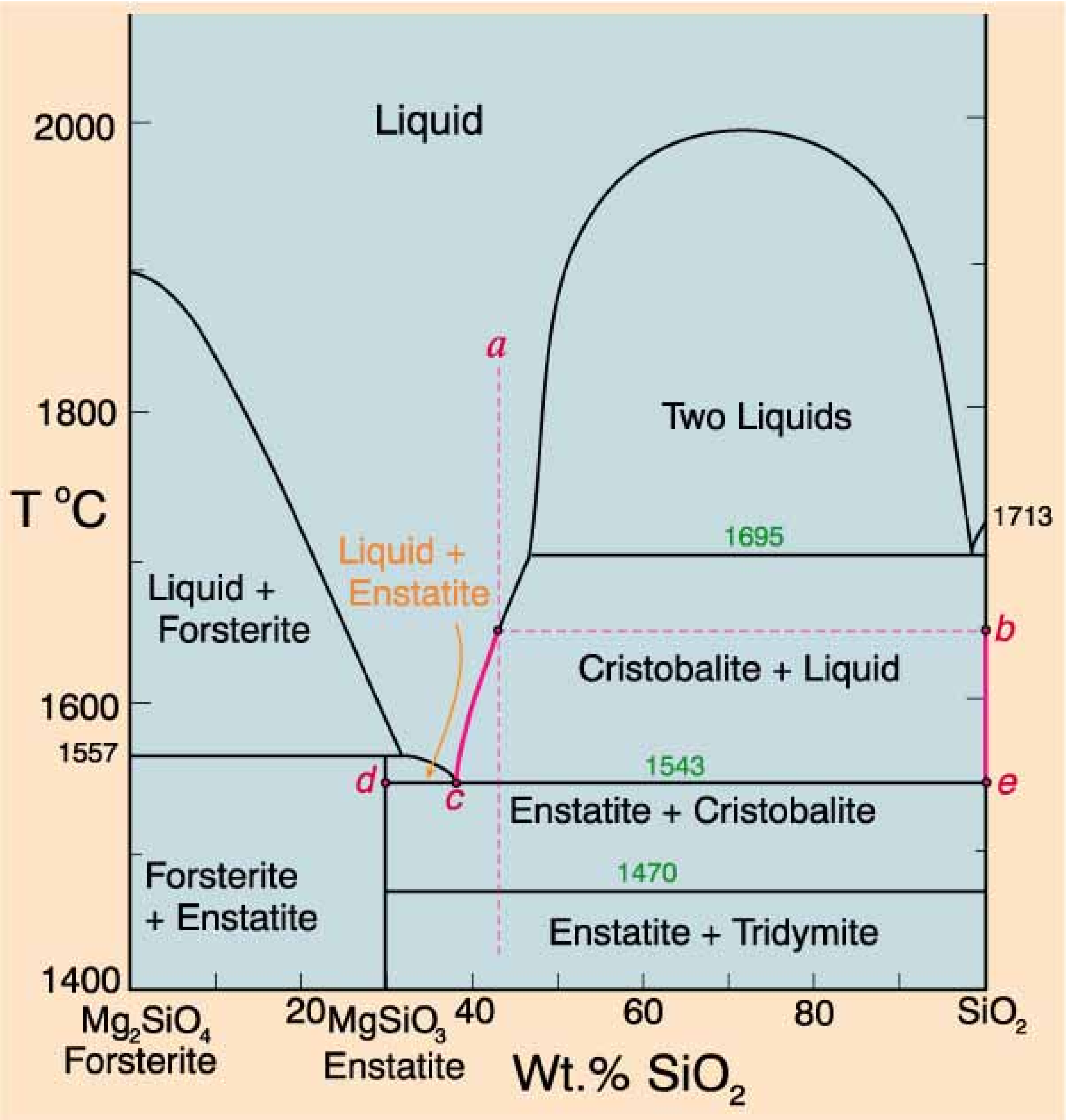
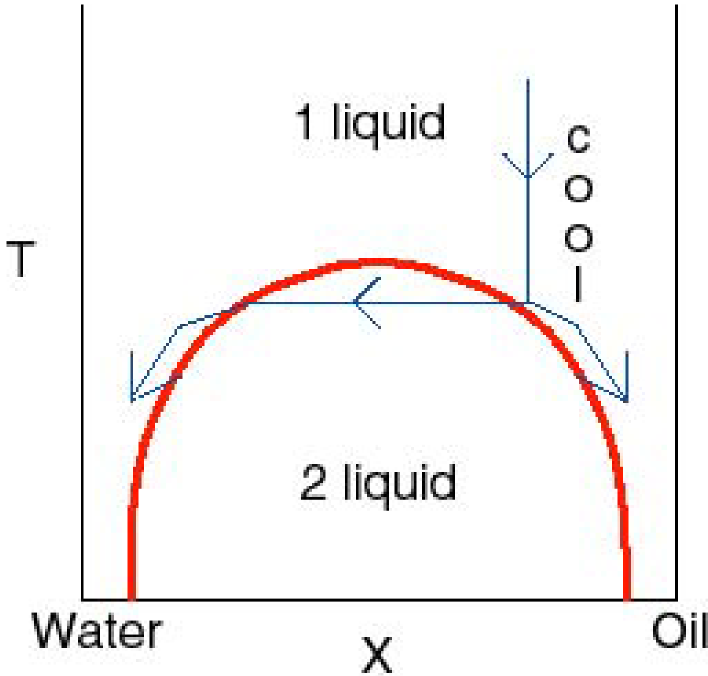


Figure 19-12. **Initial $^{143}Nd/^{144}Nd$ vs. $^{87}Sr/^{86}Sr$ diagrams for young carbonatites (dark shaded), and the East African Carbonatite Line (EACL), plus the HIMU and EMI mantle reservoirs. From Bell and Blenkinsop (1987, *Geology*, 15, 99-102), (1989, in K. Bell (ed.), *Carbonatites: Genesis 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.**

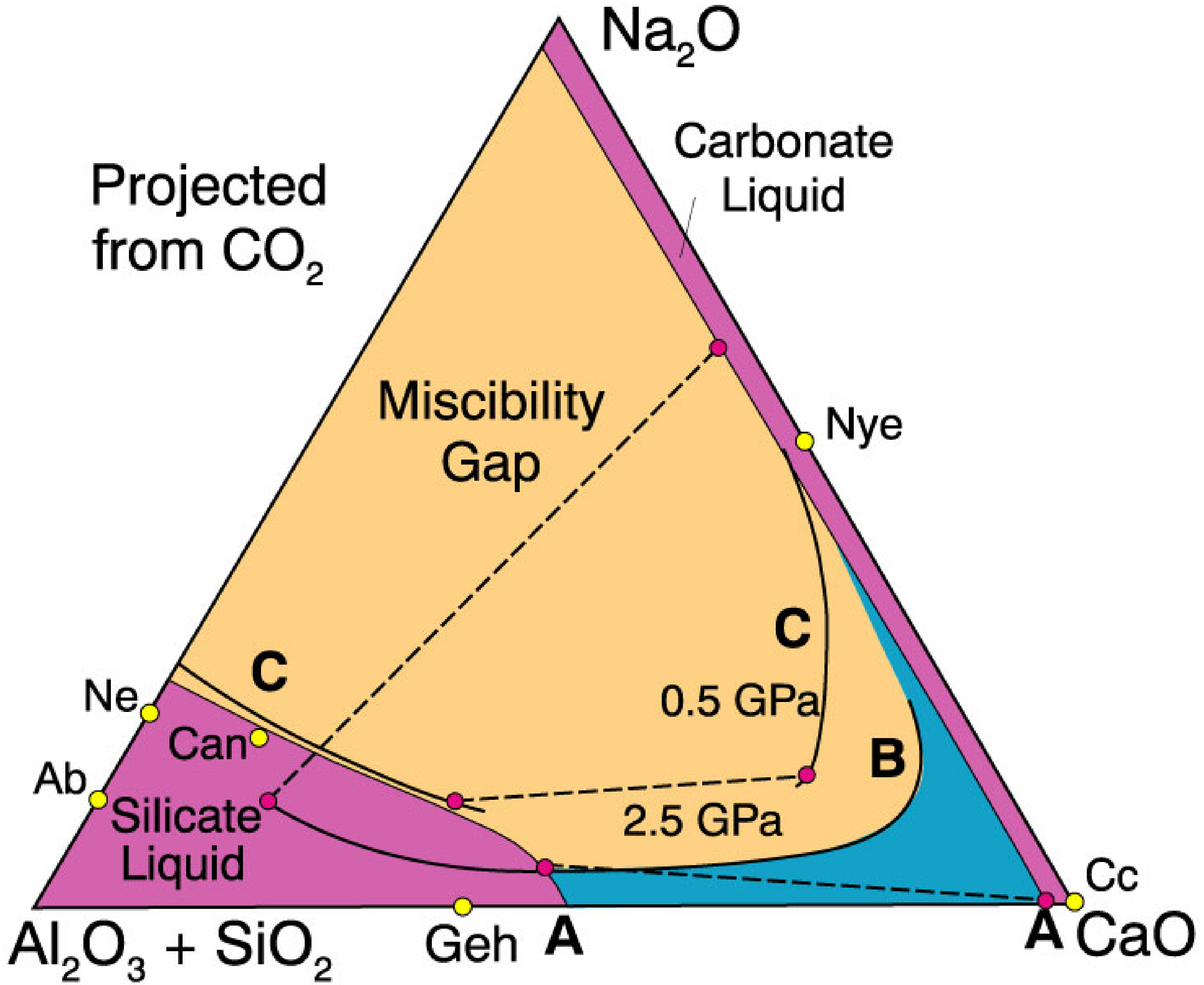
Immiscible liquids: Demo





Continental Alkaline Magmatism. Carbonatites

Figure 19-15. **Silicate-carbonate liquid immiscibility in the system Na_2O-CaO-SiO_2-Al_2O_3-CO_2 (modified by Freestone and Hamilton, 1980, to incorporate K_2O, MgO, FeO, and TiO_2). The system is projected from CO_2 for CO_2-saturated conditions. The dark shaded liquids enclose the miscibility gap of Kjarsgaard 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 Kjarsgaard 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

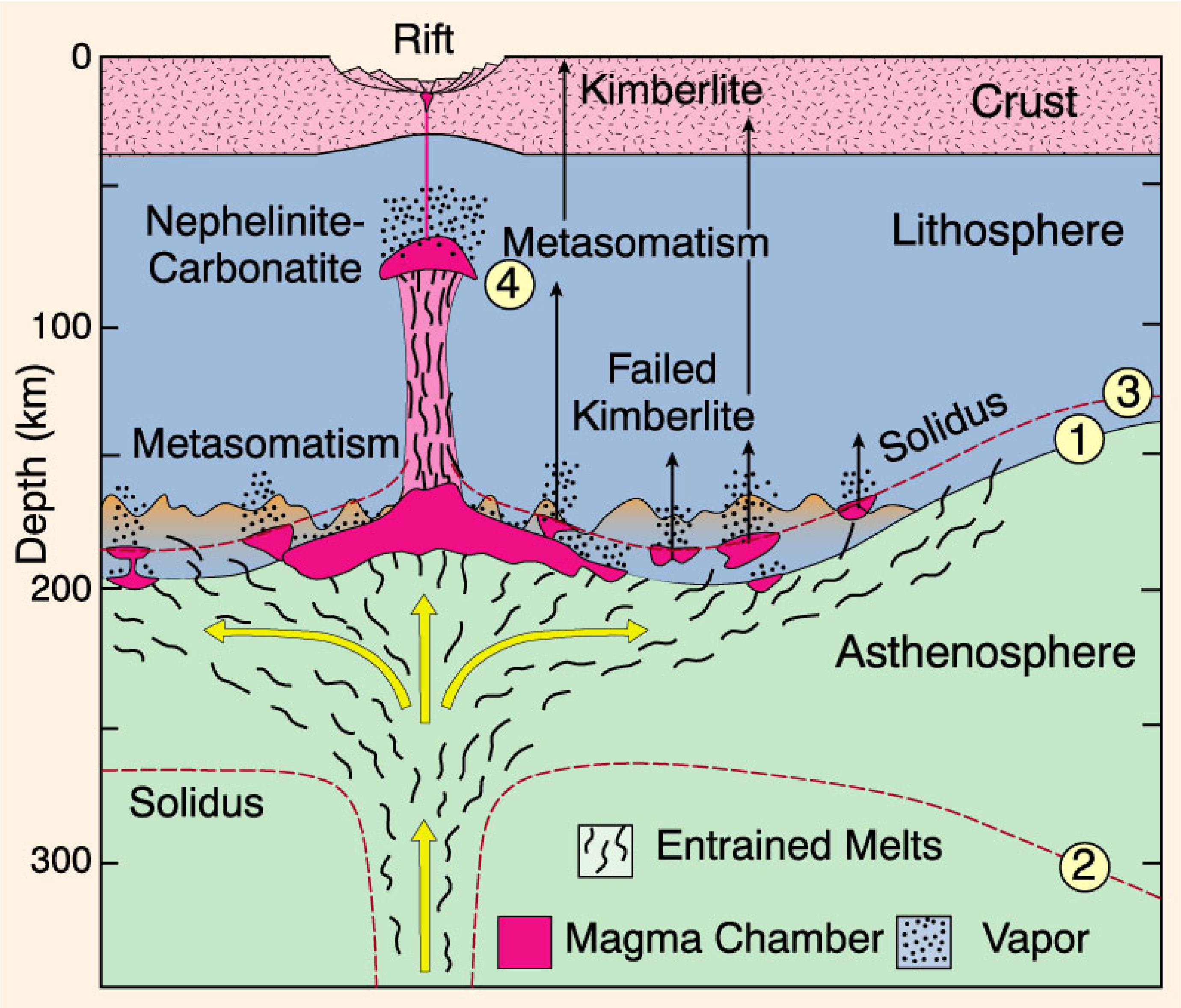


Figure 19-15. Schematic cross section of an asthenospheric mantle plume beneath a continental rift environment, and the genesis of nephelinite-carbonatites and kimberlite-carbonatites. Numbers correspond to Figure 19-13. After Wyllie (1989, Origin of carbonatites: Evidence from phase equilibrium studies. In K. Bell (ed.), *Carbonatites: Genesis and Evolution*. Unwin Hyman, London. pp. 500-545) and Wyllie *et al*., (1990, *Lithos*, 26, 3-19). Winter (2001) An Introduction to Igneous and Metamorphic Petrology. Prentice Hall.

Ol Doinyo Lengai, Tanzania

Eruption temperature: 491-544 °C

SI GVP

Chapter 19: Continental Alkaline Magmatism. Kimberlites

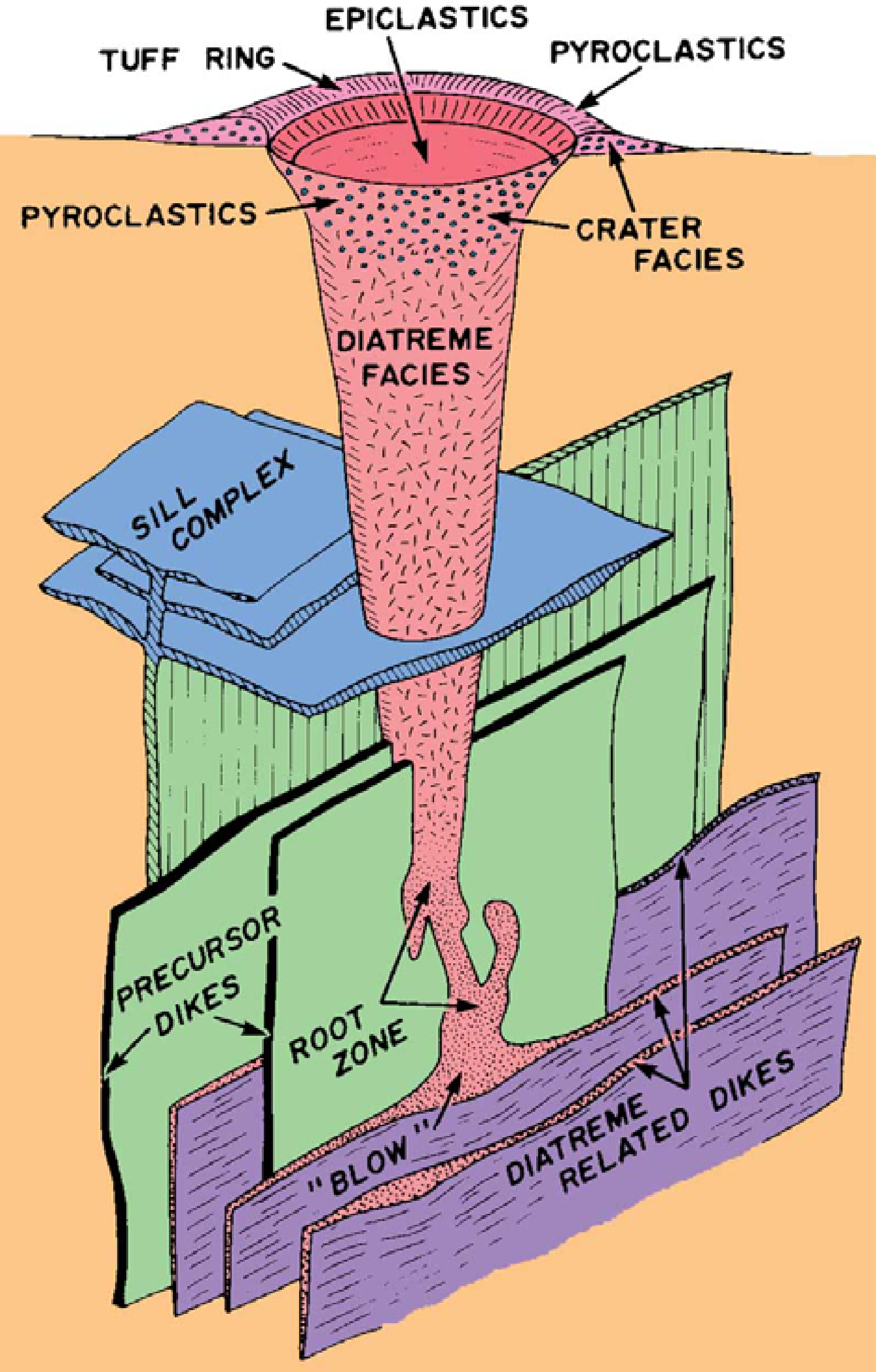


Figure 19-19. Model of an idealized kimberlite system, illustrating the hypabyssal dike-sill complex leading to a diatreme and tuff ring explosive crater. This model is *not to scale*, as the diatreme portion is expanded to illustrate it better. From Mitchell (1986) *Kimberlites: Mineralogy, Geochemistry, and Petrology.* Plenum. New York. Winter (2001) An Introduction to Igneous and Metamorphic Petrology. Prentice Hall.

Chapter 19: Continental Alkaline Magmatism. Kimberlites

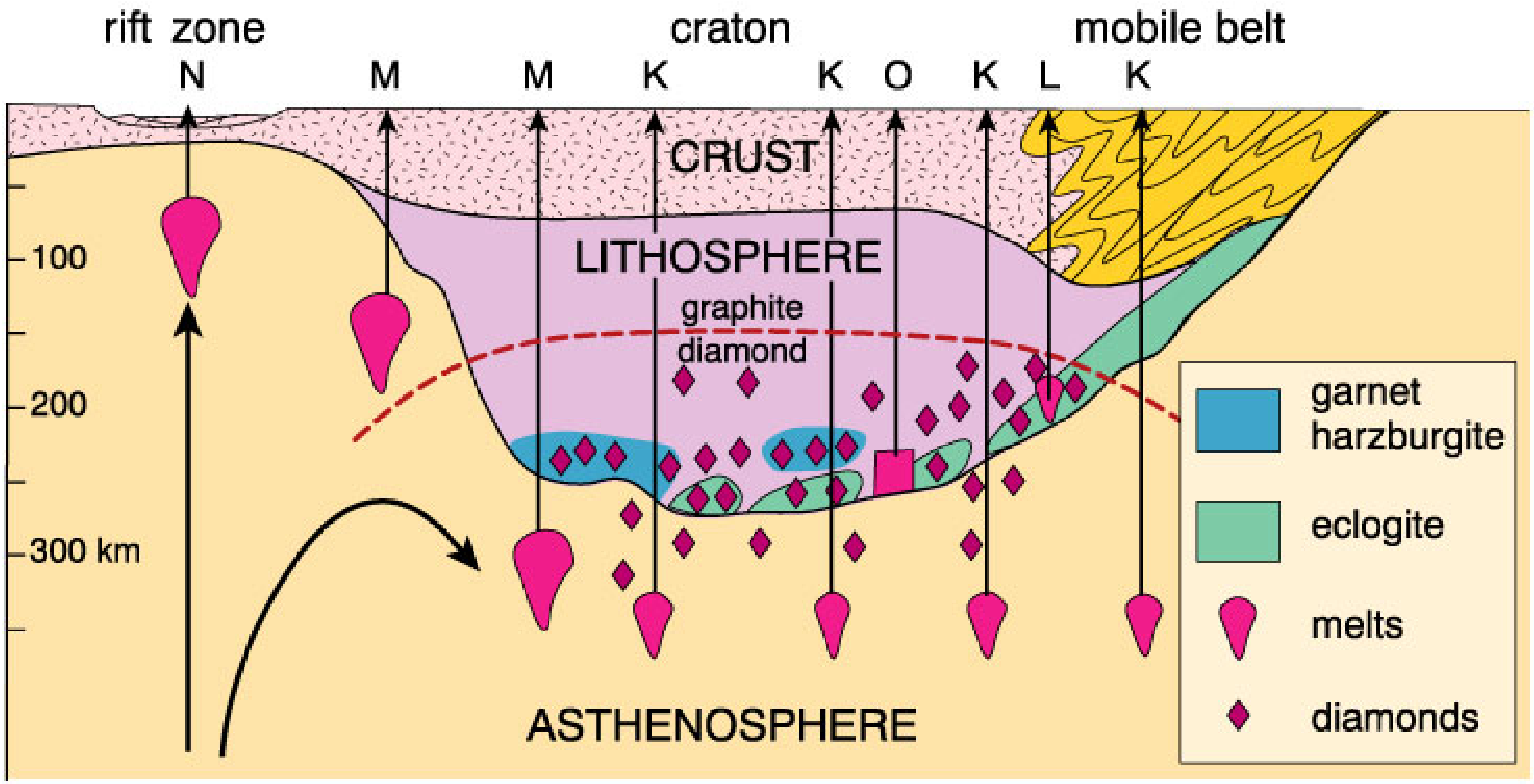


Figure 19-20b. Hypothetical cross section of an Archean craton with an extinct ancient mobile belt (once associated with subduction) and a young rift. The low cratonal geotherm causes the graphite-diamond transition to rise in the central portion. Lithospheric diamonds therefore occur only in the peridotites and eclogites of the deep cratonal root, where they are then incorporated by rising magmas (mostly kimberlitic- "K"). Lithospheric orangeites ("O") and some lamproites ("L") may also scavenge diamonds. Melilitites ("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.