

All are invited to attend the monthly meeting of the  
**Nittany Mineralogical Society**  
**Wednesday, January 18, 2012 - Program at 8:00 p.m.**  
114 Earth & Engineering Sciences Building

# **Kimberlites and Lamproites: Windows to the Upper Mantle**

by David (Duff) Gold  
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*Our January meeting will be held Wednesday the 18th in the room 114 auditorium of Earth & Engineering Sciences Building on the west side of the Penn State campus in State College, PA. Maps may be found on our web site.*

*(Junior Rockhounds: 5:00 p.m. in room 121)*

*6:30 to 7:30 p.m.: Social hour, refreshments in the lobby*

*7:30 to 8:00 p.m.: announcements, questions, answers; door prize drawings*

*about 8:00 p.m.: featured program*

*The event has free admission, free parking, and free refreshments, and is open to all –  
Bring your friends and share an enjoyable evening. -Editor*

*Kimberlites interest us because they can contain not only diamonds, but other minerals and rock fragments from deeper than we can see by other methods. They erupt from narrow volcanic pipes and may leave less evidence on the surface than most volcanics. Dr. Gold has extensive experience researching kimberlites and will describe these complex rocks in his presentation. -Editor*

Kimberlites in the broad sense are OH-rich ultramafic (silica deficient) rocks with a porphyritic texture that may contain phenocrysts and xenocrysts of pyrope-rich garnets, magnesian-rich ilmenite (picroilmenite), chrome-diopside, spinels, phlogopite and diamonds, as well as foreign inclusions (xenoliths) of exotic olivine-pyroxene-garnet-spinel assemblages. As certain minerals crystallize, the remaining melted rock tends to change or “evolve” toward being more silica-poor and carbonate-rich. Evolved varieties include phlogopite-rich (Type II) and highly potassic lamproites that may contain sanidine, feldspathoids (leucite) and unusual potassium-rich amphiboles (K-richterite), and a host of barium- and titanium-rich minerals (priderite, perovskite, wadeite). They occur in fissures or thin dikes and as “blow-outs” in diatreme breccia pipes, too far from the source to be “normal” quenched magma melts. Consistent with their high fluid content, outgassing took place at great depth, and emplacement was achieved rapidly along hydraulically driven cracks from depths of the order of 50 to 150 kilometers. Diatremes are essentially near surface structures, with both crater and vent facies preserved. No lava except for some lamproites has been verified. Outgassing fluids, with modeled velocities as high as Mach 2, plucked, entrained, rounded, polished and mixed samples of the upper mantle and lower crustal rocks, up to 60 cm across, with more angular upper crustal lithologies, and polished the walls of some of the diatreme vents. “Kimberlites” were emplaced periodically throughout geologic time with a peak during Cretaceous times (at the time of disruption of Gondwanaland, the southern supercontinent). The predominance of lamproites to the Tertiary may reflect erosion depth rather than temporal distribution.

“Kimberlites” are of interest economically as the primary source of diamonds, albeit as the dispersant rather than the concentrating agent. Of more than 9000 known kimberlitic bodies, only approximately 5% contain diamonds (mainly as “micros”, <0.1 mm) and less than 10% of these are likely to be economic. Diamond exploration focuses on extensional settings in “OLD COLD CRATONS.” “Finds” are evaluated mainly on the presence of (a) G-9 and G-10 garnets (low Ca, high Cr pyrope), (b) the absence of an oxidation trend (overgrowths) in the spinels, and (c) the P-T regime inferred from co-existing sets of minerals in the xenoliths and diamonds with respect to the diamond/graphite inversion boundary (54 kbar/1300°C) and geothermal gradient. Diamonds are classified as “p-type” for peridotitic from “fertile” asthenospheric (pristine) mantle, or “e-type” for eclogitic from a depleted or lithospheric (recycled) mantle. The latter have implications on early subduction roots.

**See our web site: [www.nittanymineral.org](http://www.nittanymineral.org)**