pyroxene, garnet, kyanite, and silica gave rise to the garnet and kyanite lamellae in the clinopyroxene. The excess silica from the reaction would have reacted with corundum to form kyanite in the observed texture.

D10

PETROLOGY OF A SUITE OF ECLOGITE INCLUSIONS FROM THE BOBBEJAAN MINE, SOUTH AFRICA. III. PARTIAL MELTING, RECRYSTALLIZATION AND P-T TRAJECTORIES

F.A. CAPORUSCIO, J.R. SMYTH
Earth & Space Sciences Division, Los Alamos National Laboratory, Los Alamos, NM 87545

A suite of eclogite nodules from the Bobbejaan Mine near Bellsbank, South Africa, all show partial melt textures and evidence of recrystallization at intermediate pressures. Most of the nodules are typical bimineralic eclogites that are associated with kimberlites, however some may contain primary phlogopite. Accessory phases are rutile, pyrrhotite and pentlandite. Jadeite components in unaltered clinopyroxene cores range from 15% to 40% by weight and may contain appreciable $Ca_{0.5}\ Al\ Si_2O_6$ (to 10 wt%). Garnet cores can contain up to 75 mol% pyrope but commonly have subequal pyrope and almandine components with up to 40% grossularite.

The epitaxial recrystallization rims of the phases show very different compositions from the cores. Clinopyroxene rims show low jadeite (to 5 wt%) and higher Ca-Tschermaks components; stoichiometry calculations indicate up to 12 wt% acmite and the absence of $Ca_{0.5}\ AlSi_2O_6$. Recrystallization phases around garnet rims are primarily orthopyroxene and spinel. The following recrystallization reactions are typical for these clinopyroxene and garnets:

(cpx) $CaAl_2Si_4O_{12} \rightarrow melt \rightarrow CaAl_2SiO_6 + 2SiO_2$

(gt) $Mg_3Al_2Si_3O_{12} \rightarrow melt \rightarrow MgAl_2O_4 + 2MgSiO_3 + SiO_2$

Pressure and temperature estimates of the crystal cores indicate that the diamondiferous eclogites equilibrate at 950° - 1100°C and 35-45 Kb. These eclogites have partially melted and recrystallized near the spinel-garnet lherzolite boundary. Aluminum content in orthopyroxene yields temperature estimates of 1250° to 1300°C while spinel chemistry (high Al/Cr) and the absence of garnet indicate pressures of 20-22 Kb during the partial melt and recrystallization episode.

D11

ORIGIN OF A SANIDINE-COESITE GROSPYDITE

K.H. WOHLETZ and J.R. SMYTH
Earth and Space Science Division, Los Alamos National Laboratory, Los Alamos, NM 87545

A grospydite xenolith from the Roberts Victor kimberlite pipe in South Africa presents an unusual phase assemblage of clinopyroxene, garnet, kyanite, coesite, and sanidine. The rock as previously described consists of 50% omphacitic clinopyroxene, 28% garnet ($Gr_{50}\ Py_{28}\ Alm_{22}$), 9% kyanite, 6% coesite, and one percent sanidine (Or_{99}). Assuming the addition of three additional compatible phases (phlogopite, enstatite, and H_2O vapor) and a simplified chemistry of the phases present a Schreinemakers thermodynamic analysis was attempted in order to estimate the pressure and temperature of equilibrium of the rock.

Four reactions involving six components are likely to have determined an invariant point for the assemblage.

(1) Kyn + 2Cpx $\rightleftharpoons$ Cos + Gt + En
(2) 3 Cos + Phl $\rightleftharpoons$ San + 3En + H_2O
(3) 3 Kyn + 6 Cpx + Phl $\rightleftharpoons$ San + 3 Gt + 6 En + H_2O
(4) 6 Cos + 3 Gt + Phl $\rightleftharpoons$ San + 3 Kyn + 6 Cpx + H_2O

Using tabulated as well as estimated thermodynamic data for the phases, the calculated values for equilibrium temperatures and pressures for the reactions yield an invariant point for the assemblage at a depth of about 104 km (32 kbars) and a temperature near 1180 K.

D12

INCLUSIONS IN THE LAKE ELLEN KIMBERLITE, NORTHERN MICHIGAN, USA

E.S. MCGEE, B.C. HEARN, JR.
U.S. Geol. Survey 951, Reston, VA 22092, USA

The recently discovered Lake Ellen kimberlite indicates that bedrock sources of diamonds in glacial deposits in the Great Lakes area could lie within the northern U.S. Magnetic surveys show that the poorly exposed kimberlite is 200m in diameter and has a body 25x90m(?) adjacent to it. The kimberlite cuts Proterozoic volcanic rocks that overlie Archean basement, but is post-Ordovician on the basis of abundant Ordovician(?) dolomite inclusions. Xenocrysts and megacrysts are ilmenite (abundant, 13-15% MgO), pyrope-almandine and Cr-pyrope (up to 9.3% Cr_2O_3), Cr-diopside (up to 4.5% Cr_2O_3) olivine (Fo 91), enstatite and phlogopite. The kimberlite sampled crustal schist and granulite, during emplacement, as well as a heterogeneous upper mantle represented by disaggregated crystals or rare xenoliths of eclogites, garnet pyroxenites and garnet peridotites. Eclogites, up to 3 cm size, show granoblastic equant or tabular textures and consist of jadeitic cpx (up to 8.4% Na_2O, 15.3% Al_2O_3), pyrope-alamandine, $\pm$ rutile$\pm$kyanite$\pm$sulfide. Garnet pyroxenite contains pyrope (0.44% Cr_2O_3) + cpx (0.85% Na_2O, 0.63% Cr_2O_3) + Mg-Al spinel. Mineral compositions of rare composite xenocrysts of garnet + cpx are distinctively peridotitic, pyroxenitic or eclogitic. Temperatures (T) of equilibration are 900-1020°C for the eclogites and 785-845°C for the garnet pyroxenite using the Ellis-Green method. Kyanite-bearing eclogites must have formed at pressures greater than 18-20 kb. Using the present heat flow value of 44mW/m^2 (shield geotherm) for the time of kimberlite emplacement, the eclogite T's imply pressures of 33-44 kb (105-140km) and the garnet pyroxenite T's indicate pressures of 24-29 kb (75-90 km). Five peridotitic garnet-cpx composite xenocrysts have T's of 880-1125°C (Lindsley-Dixon, 20 kb solvus); T's of three, if on a shield geotherm, imply pressures within the diamond stability field.

D13

PETROLOGY OF THE EGLAZINES KIMBERLITE-LIKE INTRUSION

E.T. BERGER, M. VANNIER,
Pétrologie-Thermochimie, E.N.S.M.P., 35, rue St. Honoré 77305 Fontainebleau, France)

The Eglazines pipe belongs to the Causses volcanic province where only alkali basalts occur, usually bearing high-pressure phases (megacrysts, spinel-garnet pyroxenites of the Al-Ti-augite group, spinel-peridotites and at Eglazines also spinel-garnet pyroxenites and spinel-garnet peridotites).

Two new geothermometers, one new geobarometer and one new "oxygen fugacitimeter" are used in this study.

The pyroxenites include spinel-free pyroxenites equilibrated from 1160 to 1220 C°, spinel websterites (1000 → 1050 C°) and spinel-garnet pyroxenites. Spinel peridotites are composed of two groups. The former consists of coarse-grained peridotites equilibrated near 1000 C° ($f\ O_2 \simeq 10^{-10}$ atm.) the latter group is composed of peridotites (1200 → 1250 C°) reminding of some porphyroclastic peridotites from kimberlite xenoliths of South Africa.

The spinel-garnet peridotites plot into the lherzolite field. Thin section observations suggest that spinel is not the result of resorption (by lowering of pressure) of an earlier garnet-bearing rock. Therefore these xenoliths may be assigned to the spinel-garnet boundary. It would have equilibrated near 25 kb at a temperature of some 1230 C° ($f\ O_2 \simeq 10^{-9.5}$ atm.).

D14

PERIDOTITES FROM THE OLMANI SCORIA CONE, N. TANZANIA

A.P. JONES, J.B. DAWSON, J.V. SMITH
Department of Geophysical Sciences,
University of Chicago, Illinois 60637,U.S.A.

Basaltic scoria of the Olmani volcano, 10km SE of Arusha, N. Tanzania, contains blocks of dunite, harzburgite, lherzolite and diopside-rich wehrlite. The texture of most is porphyroclastic; large (>1cm) deformed olivine grains exhibit multiple planar extinction discontinuities, and there is abundant evidence for grain-boundary migration between adjacent deformed grains; subgrains are also developed. In orthopyroxenes, exsolution of opaque platelets takes place at extinction discontinuities. Large olivines are forsterite (Fo_{92-93}), but smaller re-crystallized, strain-free grains are more Fe-rich (Fo_{88}). Enstatite (En_{90-92}) is low in Al_2O_3 (1-2wt %) and Ca (0-0.4), Both enstatite and Cr-diopside (mg 0.93, up to 2.2% Na_2O, up to 3.2% Cr_2O_3) may occur in "fingerprint" intergrowths with Mg-chrome spinel (MgO 12-15%, Cr_2O_3 52-66%). Fine-grained material (?devitrified glass) associated with some cpx-chromite intergrowths is K-rich (4.7-5.7%) and very variable in composition (e.g. SiO_2 46-54%, MgO 4-19%, CaO 1-3%) and with low totals (?hydrous). In one specimen high-Na glass of variable composition (e.g. Na_2O 6.2-8.2%, K_2O 2.7-4.0, SiO_2 44.2-49.9) but apparently anhydrous (totals 98.4-101.3), has developed adjacent to cpx grains. The development of these alkali-rich basic melts from upper mantle material may be significant in models for the alkali-basalt province of N. Tanzania

D15

GARNET LHERZOLITE AND OTHER INCLUSIONS FROM A BASALT FLOW, BOW HILL, TASMANIA

F.L. SUTHERLAND, J.D. HOLLIS, L.M. BARRON
Department of Mineralogy and Petrology, The Australian Museum, 6-8 College Street, Sydney, Australia 2000

Garnet lherzolite xenoliths at Bow Hill, Tasmania are a rare occurrence from a basalt flow. Such xenoliths are known from alkali basalt (mainly breccias) in France, U.R.S.S., Mongolia, Patagonia, Japan, Hawaiian Islands and E. Australia. The Tasmanian examples occur with garnet websterite, spinel lherzolite, spinel websterite, spinel wehrlite and crustal inclusions. Statistical counts give a ratio of garnet lherzolite to spinel lherzolite of about 1 to 500 and between 60-75 % peridotites, 5-10 % pyroxenites and 20-30 % crustal rocks for the suite. Apart from cumulate spinel wehrlite, the ultramafic inclusions represent accidentally derived mantle material.

The garnet compositions ($Mg_{70-78}Fe_{13-18}Ca_{8-13}$) lie at the magnesian extreme for E. Australian basaltic and kimberlitic inclusions. They occur with Al orthopyroxene ($Mg_{83-89}Fe_{9-14}Ca_2$), Al clinopyroxene ($Mg_{52-54}Ca_{38-41}Fe_{4-9}$) ± olivine ($Mg_{90-93}$). Compositions are based on micro-probe analyses with total Fe as Fe O.

The host nepheline hawaiite belongs to a Tertiary, mafic K-rich alkaline lineage in Tasmania. The megacryst and cumulate minerals include olivine (Mg_{82}), Al clinopyroxene ($Mg_{42-46}Ca_{44-49}Fe_{9-11}$) and spinel ($Mg_{85}Fe_{35}$). Chemical mixing by addition of observed proportions of these compositions suggest that the host evolved by 20 % crystallisation of wehrlite from a primary parental basanite. Similar basanites are found in the area.

P-T estimates for the garnet lherzolite and garnet websterite from a variety of geobarometers and geothermometers range between 17-31 kb and 1130-1320°C. (Carswell and Gibbs, 1980, Nodmins programme ; Herzberg, 1978). This data indicates an origin in the mantle lying without the diamond stability zone. The lower P-T values may be the more realistic as they match experimental sub-liquidus crystallisation of wehrlite minerals from compositions related to the parental basanite (< 26 kb, 1300°C ; Arculus, 1975).

The xenolith assemblages allow a composite reconstruction of the lower crust and upper mantle under central Tasmania. The mineral compositions demonstrate the care needed to distinguish true kimberlites from basaltic occurrence, using similar indicator minerals.

Arculus R.J., 1975 Carnegie Inst. Washington Yearb,74,512-515
Carswell D.A., Gibbs G.F.G., 1980 Contrib. Mineral Petrol, 74 403-416
Herzberg C.T., 1978 Geochim.Cosmochim.Acta., 42, 945-957

D16

PETROLOGY AND GEOCHEMISTRY OF MANTLE ECLOGITE XENOLITHS FROM COLORADO-WYOMING KIMBERLITES

P.C. ATER, M.E. McCALLUM and D.H. EGGLER
Department of Earth Resources, Colorado State University, Fort Collins, Colorado 80523 ;

Eclogite xenoliths from Colorado-Wyoming kimberlites can be divided into two groups based essentially on absence or presence of kyanite and(or) corundum, and corresponding metaluminous or peraluminous character. Metaluminous eclogites generally are granoblastic and contain one or more of the accessory phases rutile, sanidine, graphite, quartz and sphene. Peraluminous eclogites commonly are foliated or layered and may contain accessory rutile and sanidine. Compositions of clinopyroxene and garnet overlap between the two groups; however, clinopyroxenes in peraluminous xenoliths generally are higher in jadeite and Ca-Al components, whereas garnets are higher in grossular component and lower in almandine. Equilibration temperatures, calculated from Fe-Mg partitioning between clinopyroxene and garnet, range from 794°C to 1163°C for an assumed pressure of