GREEN MOUNTAIN KIMBERLITE, COLORADO: MINERALOGY AND PETROLOGY.

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The Green Mountain diatreme, near Boulder, Colorado, is presently the most southerly occurrence of kimberlite in the Colorado-Wyoming region. It is approximately 100 miles south of the main field of diamond-bearing kimberlites described by McCallum et al. (1975). Tectonically it is similar in position to the northerly kimberlites in that it has intruded pre-cambrian Boulder granite. However, the original geometry of the intrusion has been modified subsequently by the Laramide orogeny. An attempt to date the intrusion using palaeomagnetic data proved ambiguous (Kridelbaugh et al., 1972) and it is most likely that this kimberlite is comparable in age with those of the State Line region which are supposedly Devonian.

The rock comprising the diatremes was first described by Whitaker (1902) who referred to it as an olivinite dike. Whitaker believed similar rocks occurred in a line 7 miles to the west and thus the idea of a dike was instituted. However, up to the present time no other occurrences of kimberlite have been verified to the west and the Green Mountain diatreme appears to be a single isolated body. It is relatively small, about 100 ft. in diameter and is completely enclosed by Boulder granite. The rock is dark in color and relatively hard, although some variations in petrographic type are obvious. Generally, the rock is characterized by large ($\leq$5cm) xenocrysts of emerald green diopside, as well as coal-black Mg-ilmenite and smaller xenocrysts of red-purple garnets (Table 1). The kimberlite varies from fine grained with few inclusions to coarser grained varieties containing phenocrysts of olivine and enstatite. These phenocrysts are partly serpentinized as are also the similar minerals of the groundmass, which includes mica, carbonate and opaque phases (Boctor and Meyer, 1977). Xenoliths of Boulder granite are common as well as samples of biotite gneiss, garnet granulites and related rock types. Presumably, these xenoliths represent basement sub-crustal rocks beneath the Boulder granite. Evidence for mantle xenoliths is not conclusive but possible altered fragments of eclogite and garnet-peridotite may have been observed.

The major silicate phase is olivine, often serpentinized, and this mineral occurs both as large phenocrysts and smaller ground mass crystals. Generally, the phenocrysts are more Mg-rich than those in the ground mass (Fo_{92} versus Fo_{84})

(Table 1). Pyroxenes occur as both clino- and orthopyroxene types. The orthopyroxene is usually comparable and associated with olivine in size and occurrence, and is enstatite (En_{91}). Hypersthene (En_{60}) has been recognized in samples of the granulite xenoliths. The clinopyroxene in the kimberlite is emerald green and appears as large xenocrysts having a relatively restricted compositional range ($Mg_{55}Ca_{41}Fe_4$) and Ca/(Ca+Mg) of about 0.43. Cr_2O_3 is present up to 1.6 wt% and is approximately equal to Al_2O_3 in content. Na_2O amounts to about 1.5 wt%. If these diopside xenocrysts are assumed to coexist with enstatite and garnet and to have equilibrated in the presence of these two phases then from the diopside-enstatite solvus one obtains a temperature of equilibration of about 1100°C.

Ilmenite occurs as large xenocrysts and also as smaller crystals in the ground mass. The xenocrystic ilmenites are Mg-rich with up to 13 wt% MgO. Chromium contents of these ilmenites are generally low, averaging about 0.4 wt% Cr_2O_3 (Table 1). Phlogopite mica is present and may occur as large crystals or be also scattered throughout the matrix. The mica appears to be characterized by containing up to 6 wt% TiO_2 (Table 1). Some biotite is also present but it is likely this is from diaggregated Boulder granite and from biotite gneiss xenoliths.

Garnets that occur in the Green Mountain kimberlite are either purple-red in color or dark orange. As in most kimberlites this feature is related to varying contents of Cr, Fe and Ca. However, all xenocryst garnets analyzed are typical of kimberlitic garnets. Other garnets analyzed during this study include samples from the garnet granulites as well as garnet in association with ilmenite. In this latter case the garnet is much more almandine-rich and the ilmenite is poor in Mg. Whether this assemblage is part of a xenolith is unknown.

References

1. Boctor, N.Z. and Meyer, H.O.A. (1977). These Abstracts.
2. Kridelbaugh, S.J.; Hobbitt, R.; Kellogg, K. and Larson, E. (1972). Abst. Geol. Soc. Am. Program with Abst., 4, p. 386.
3. McCallum, M.E.; Eggler, D.H., and Burns, L.K. (1975). Phys. Chem. Earth, 9, 149-162.
4. Whitaker, M.C. (1902). Colorado Sci. Soc., Proc. 6, 104-118.

Table 1. Representative analyses of minerals from the Green Mountain diatreme, Boulder, Colorado.

Oxide	Olivine	Enstatite	Diopside	Ilmenite	Garnet	Garnet	Phlogopite
SiO_2	42.6	56.9	54.0	-	41.1	42.4	36.2
TiO_2	0.04	0.12	0.23	53.2	0.02	0.69	5.50
Al_2O_3	0.02	0.65	1.63	0.49	18.2	21.0	15.0
Cr_2O_3	0.02	0.21	1.43	0.43	5.6	1.08	<0.01
FeO	7.62	5.51	2.78	31.9	7.39	11.2	14.6
MnO	0.14	0.14	0.11	0.28	0.44	0.39	<0.01
MgO	51.2	35.3	18.5	12.4	19.9	19.6	14.5
CaO	0.01	0.89	19.3	0.02	5.97	4.18	<0.01
Na_2O	-	0.12	1.63	<0.01	<0.01	<0.01	0.11
K_2O	-	-	0.03	-	-	-	9.41
Total	101.6	99.8	99.6	98.7	98.6	100.5	95.3 (+OH)