LEIGHTON GAS-RICH CHONDRITE: TRACE ELEMENT CONTENTS
AND MINERALOGY/PETROLOGY OF SELECTED INCLUSIONS. S. Biswas*,
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From limited chemical and mineralogic data, it was suggested
(1-3) that dark, gas-containing portions of gas-rich meteorites
represent admixture of carbonaceous chondrite material to the
light, low-gas portions. Prior trace element data (4) were in
conflict with this suggestion and we have been studying the dis-
crepancy by examining mineralogic/petrologic and chemical char-
acteristics of coexisting light/dark pairs of samples from 8 gas-
rich chondrites (5-7). The distinct but non-uniform volatile
element enrichment in the dark portions and the samples' miner-
alogic properties preclude admixture of carbonaceous chondrite
material, indeed any component with fixed composition (5-7). One
aspect not examined in these studies is the extent to which
mineralogic/petrologic and chemical variations occur within a
single meteorite; we remedy that deficiency here by reporting
trace element data and some mineralogic information for 10 se-
lected portions of the Leighton (H5) light/dark, gas-rich chon-
drite.

We chose to study the Leighton chondrite because of its un-
usually high volatile trace elements contents (5). From our
mineralogic/petrologic survey (6), its properties are typical of
H-group gas-rich chondrites. We selected regions for study from
the front (F) and back (B) of the hand specimen, designating each
as light (L) or dark (D) based on its appearance and giving it an
appropriate number. We attempted to sample representative parts
of this brecciated chondrite. Samples FLO and FDO were those
studied previously (5,6); we chose FL1 and FL3 because of their
similar appearance in the hand specimen. We prepared a thin sec-
tion of each sample for mineralogic study; another aliquot was
used for neutron activation analysis of 12 elements (Ag, Bi, Cd,
Co, Cs, Ga, In, Rb, Se, Te, Tl and Zn).

Mineralogically, all Leighton samples resemble each other
and have Fa and Fs contents in olivine and pyroxene, respectively
consistent with those of H-group chondrites. All dark samples
and BD1, at least, contain ferromagnesian minerals inhomogeneous
with respect to Fe²⁺ concentration; the semi-quantitative dis-
equilibrium parameters expressed as percent mean deviation (PMD)
ranges from 2-34 for olivine and 2-38 for pyroxene (Figs. 1,2).
On average, light samples are more equilibrated than dark ones
but there is some overlap. The 3 most unequilibrated samples
FD2, FD3 and BD1 - have lower Fs contents than the others; a
similar phenomenon is observed in unequilibrated ordinary chon-
drites (8). Most dark samples contain taenite with Ni and Co
contents approaching those of kamacite (Fig. 3); these ranges
exceed those of equilibrated or unequilibrated H-group chondrites
(6,9). An exception is BD1 (Fig. 3) which, in terms of metal
composition, resembles H5-6 chondrites (6,9) but, in terms of
ferromagnesian minerals, is one of the most unequilibrated.

Concentrations of a few trace elements vary only slightly in
the samples: Co, 535-978 ppm; Ga, 3.36-7.39 ppm; Se, 5.31-10.1
ppm; Zn, 23.6-70.5 ppm. Concentrations of other elements vary
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widely: Ag, 19.4-628 ppb; Bi, 1.35-907 ppb; Cd, 6.26-47.5 ppb; Cs, 18.6-1270 ppb; In, 0.89-238 ppb; Rb, 3.07-417 ppm, Te, 181-2990 ppb; Ti, 0.77-201 ppb. Some of these exceed contents in the most volatile-rich H-group chondrites. Concentrations of some elements-Bi, Cd, In, Te, Ti- vary directly with the PMD parameter (Fig. 2). Assuming that the Si content of each inclusion is that of H-group chondrites, abundances of Bi, Cs, In and Rb exceed C1 levels in 2-6 samples and Ag and Te are supercosmic in 1 sample each. While some exceed C1 levels by only a few percent, others are enriched by factors of 2-125.

The data are not yet sufficient to determine whether the samples reflect only primary process(es) or whether they represent regions of a parent body enriched in volatiles by secondary processes. However, it is clear that the samples comprise a suite of H-group parent material having a broad range of volatile element contents and states of disequilibrium. On average, dark samples are more volatile-rich and unequilibrated than light ones and the data suggest a population continuum, although it is conceivable that two separate overlapping populations may be present. In any event, there is no evidence that dark regions of Leighton (and other gas-rich chondrites) include any volatile-rich component other than H-group material.


Fig. 1. Histograms of olivine and pyroxene compositions in 5 dark portions of Leighton H5 chondrite. All are unequilibrated having values of the silicate disequilibrium parameter (PMD) consistent with those in H3,4 chondrites.
Fig. 2. Bi, In and Tl abundances versus PMD parameter in 10 Leighton samples. Abundances of these elements, Cd and Te vary directly with PMD. Some abundances exceed CI values indicated on the center line.

Fig. 3. Compositions of kamacite and taenite in 5 dark portions of Leighton. Ni and Co contents for taenite in all but BD1 approach those of kamacite thus resembling trends in H3 chondrites (9). The contents in BD1 are like those in H5,6 chondrites but BD1 is clearly unequilibrated in ferromagnesian minerals.