Chelyabinsk is an LL5 ordinary chondrite. Three general lithologies with varying shock features are found among recovered meteorites. These are:

- Light-colored lithology shock to C-S4 level.
- Dark-colored lithology shocked to C-S5 (shock-darkened). Extensive melting limited mainly to sulfides occurs. Sulfide melt forms a dense web of fine veins impregnating the inter- and intra-granular pore space within crushed silicate grains and is the main darkening agent.
- Impact-melt lithology is a breccia of crushed mineral grains with various amounts of whole-rock melt and corresponds to level C-S6-7.

Altogether, 4 zones are observed corresponding to (1) shock levels C-S4 at the rim, followed with (2) sulfide melt rich zone (C-S5), (3) zone with extensive silicate melting (C-S6) and (4) entirely molten phase in the sample interior (C-S7). Zone 1 corresponds to original Chelyabinsk light-colored lithology, zone 2 to dark-colored lithology, and zone 4 to impact-melt lithology. The zone 3 is new and is not found among Chelyabinsk meteorites. Based on our observations Silicate melt coats residual silicate solid phase and prevent molten troilite to enter silicates and associated darkening.

**Optical properties**

Zone 1 resembles typical visible-near-infrared (Vis-NIR) ordinary chondrite spectra. Zones 2 and 4 are significantly darkened with attenuated silicate absorption bands and resemble spectra of shock-darkened ordinary chondrites. Zone 3 is optically intermediate between the zone 1 and shock-darkened zones 2 and 4. Mid-infrared (MIR) reflectance does not follow the reflectance order in Vis-NIR. Reststrahlen silicate bands, are not significantly attenuated. No significant shock-induced wavelength shift in the MIR spectra features is observed.

**Conclusions**

The spherical shock experiments reproduced Chelyabinsk light-colored, dark-colored, and impact-melt lithologies. Surprisingly, new lithology was observed at pressures intermediate between dark-colored and impact-melt lithologies. Within this zone, silicate melting along crystal boundaries isolates troilite melt and prevents silicate darkening. This observation implies on narrow pressure conditions responsible for shock darkening of ordinary chondrites. At the onset of silicate melting, shock darkening effects in ordinary chondrites cease and reappear again only upon complete melting.

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