LABORATORY SIMULATIONS RELEVANT TO CV PARENT BODY ALTERATION.

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Bamle bronzite was crushed and sieved to obtain particles in the 500-1000 μm range. One sample was made by mixing this with 10 μm wustite powder and pressing into a 1 cm diameter pellet. A second was made similarly but included less than 100 μm sodalite. A third was made including instead synthetic pentlandite with equal molar concentrations of Fe and Ni. These were closed in separate, fairly tight Fe crucibles and heated simultaneously in a tube furnace in a slowly flowing Ar atmosphere for 100 hours at 900°C.

Polished sections across these samples have been examined optically and with an analytical scanning electron microscope. The observations are generally strongly favorable to the parent body alteration hypothesis. They provide several important bits of information that could not be inferred from thermodynamics alone.

1. All three samples show extensive formation of Fe-rich olivine. In samples one and three it is the only new silicate formed. It formed on all bronzite surfaces. It forms rims tens or even hundreds of μm thick and yet never shows detectable composition gradients in either the bronzite or the new olivine near the interface. Textures frequently resemble those shown in Fig. 2a, b of (1) which had been earlier argued by others to suggest overgrowth rather than reaction.

2. The matrix textures of samples one and two do not suggest dramatic coarsening of wustite or strong welding to bronzite. This, together with the universal presence of olivine rims, suggests that Fe may have been transported in the vapor phase. The possible transport of various elements including Fe as hydroxides during meteorite alteration has been suggested by Hashimoto in another context. Our crucibles were rusty prior to the runs and it seems marginally possible that internal water vapor pressures were high enough to make such transport important. In any case, it could be in a meteorite parent body.

3. Our starting wustite contained trace amounts of Al. This led to the formation of μm sized hercynite crystals in all samples. These were enclosed in the residual magnetite formed from wustite during cooling, with sharp contacts. Therefore, such intergrowths and presumably similar ones with chromite do not imply exsolution of a mixed spinel during slow cooling.

4. In sample three, which contained pentlandite, a sulfide-oxide liquid formed as anticipated. This wet and coated all bronzite grains and flowed into cracks. It produced reaction so extensive (Fig. 1a,b) that only the cores of the largest bronzite grains were unaffected.

5. In sample two, sodalite only decomposed to a limited extent leaving rims of nepheline a few μm wide. These showed little evidence of reaction with the matrix.

6. The Na, which was released from sodalite, had a dramatic affect on the reaction of wustite with the bronzite. In this sample, a thin Na-bearing Si-rich glass always separates the bronzite from the reaction products. The products in this case include both Fe-rich olivine and pyroxene. These products frequently form fine grained porous intergrowths resembling strongly in this respect actual CV meteorite matrix (Fig. 1c,d).

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(1) Housley and Cirlin, Chondrules and Their Origins, LPI (1983).

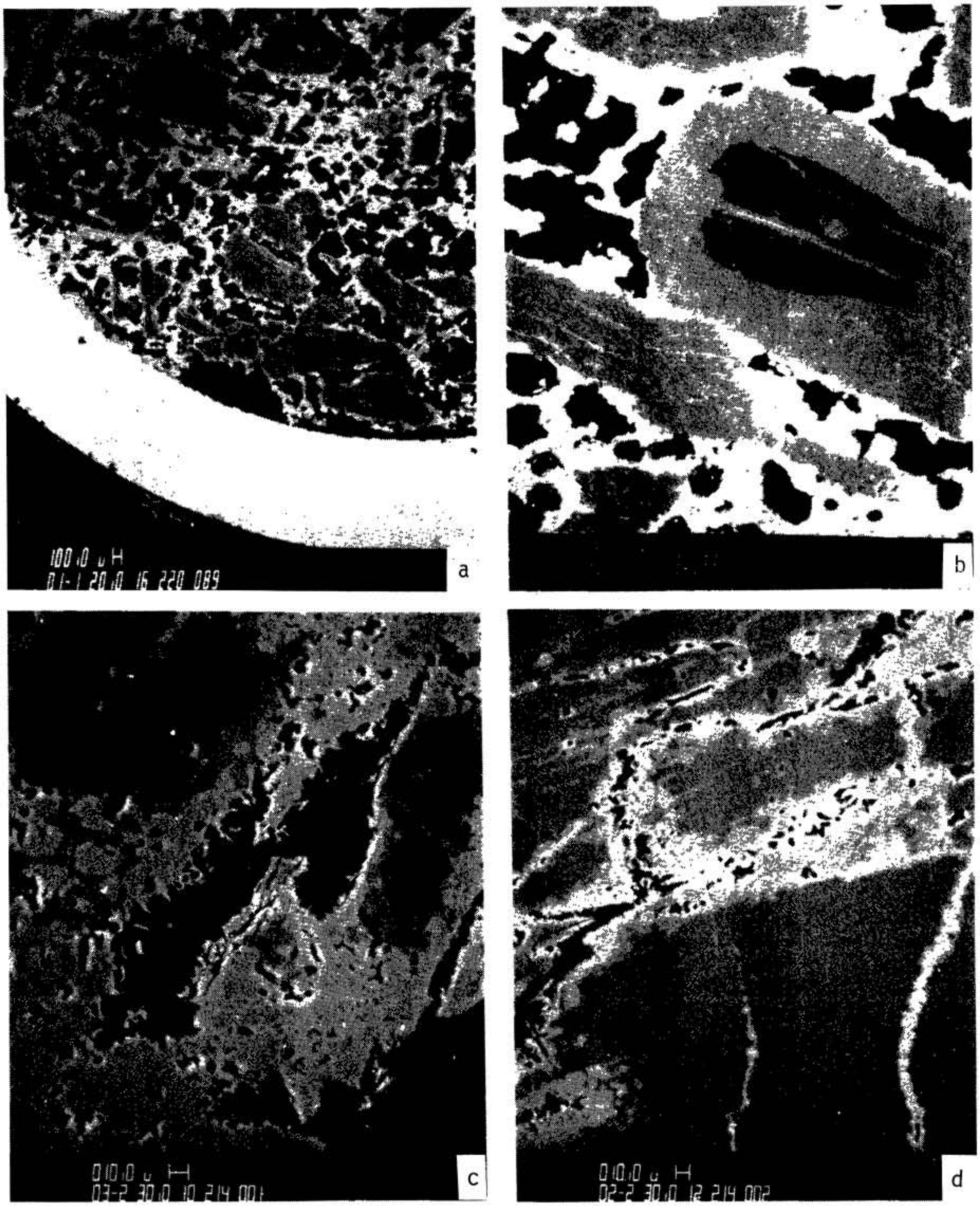

Fig. 1 - Backscattered electron images showing extensive reaction of wustite with bronzite. a and b) Sample three. White circular arc, Fe crucible; large medium-gray grains largely Fe-rich olivine reaction product; dark gray, bronzite cores; light rims, magnetite plus metal; dark, voids. c and d) Sample two. Bronzite, darker, plus fine-grained Fe-rich olivine and pyroxene reaction products, lighter.