SECONDARY SULFIDES IN HYDROTHERMALLY ALTERED IMPACTITES AND BASEMENT ROCKS OF THE CHICXULUB PEAK RING – A PRELIMINARY SURVEY

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Introduction: Impactites and uplifted basement lithologies recovered from the new IODP–ICDP Expedition 364 drill core M0077A into the peak ring of the ~180 km Chicxulub impact structure, Yucatán, Mexico [1] have been, similar to rocks elsewhere in the crater [2], intensely hydrothermally altered. While [3,4] provide a general characterization of the complex hydrothermal alteration pattern and mineral assemblage across the M7700A core, the present study is focused on secondary, hydrothermally grown, sulfide minerals at various depths in the drill core.

Samples and Analytical Methods: Sample thin-sections include: (a) 40–2–5–7, suevite, depth ~618 mbsf; (b) 40–2–105–107, suevite, ~619 mbsf; (c) 50–3–81–83, suevite, ~649 mbsf; (d) 63–2–69.5–72, suevite, ~685 mbsf; (e) 85–1–26–28, impact melt breccia, ~717 mbsf; (f) 89–3–13.5–15, impact melt breccia, ~729 mbsf; (g) 94–3–41–45, impact melt breccia, ~744 mbsf; (h) 151–1–30.5–32.5, shocked dolerite, ~887 mbsf; and (i) 206–3–54–56, shocked granite with impact melt breccia, ~1039 mbsf. Analyses were conducted with a JEOL 5910LV scanning electron microscope and a CAMECA SX 100 electron microprobe (15 kV, 20 nA, 1 µm spot size, FeKβ/CoKα interference correction) at the Johnson Space Center.

Results and Outlook: The M0077A impactite sequence hosts several secondary sulfides (see [5] for a description of sulfide minerals from the K/Pg transition interval at ~617 mbsf). Sample (a) contains pyrite (Py) with subordinate chalcopyrite (Ccp) and sphalerite. A cm-sized domain of blocky, locally cockscomb-textured Py and/or marcasite intergrown with calcite fills a (degassing?) vug in sample (b) (Fig. 1A). Sample (c) is dominated by Ccp. Sample (d) contains, in addition to crystals of Py and Ccp, clusters of framboidal Py (≤0.1 wt% Mn and Cu) forming spheroidal, microcrystalline aggregates ≤20 µm across (Fig. 1B), associated with secondary Na-dachiardite, heulandite, and analcime [3,4]. A chlorite alteration zone in this sample hosts multiple aggregates of Co-Ni-Cu-rich Py (in places 'bravoite'; e.g., [6]), with ≤9.1 wt% Co, ≤4.3 wt% Ni, and ≤2.8 wt% Cu (Fig. 1C). Idiomorphic Py lining melt vesicles in sample (e) has ≤1.8 wt% Ni (Fig. 1D). Sample (f) has Py and Ccp; sample (g) contains Py. Former olivine altered to mafic sheet silicates in (h) contains Py rich in Ni (≤9.7 wt%), As (≤1.3 wt%), and Co (≤1.0 wt%), and Ccp locally enriched in Ni. Sample (i) contains Py (≤1.7 wt% As) and some minor galena. Figure 1E summarizes select Fe-sulfide compositions. The secondary sulfide in the Chicxulub core lithologies may be a geothermometer for hydrothermal alteration and an indicator of fluid chemistry [2,5]. The origin and stability of Co-Ni-Cu-rich Fe-sulfide, and a possible biogenic origin of framboidal pyrite in zeolite fillings within the suevite unit [3], are the matter of ongoing studies.

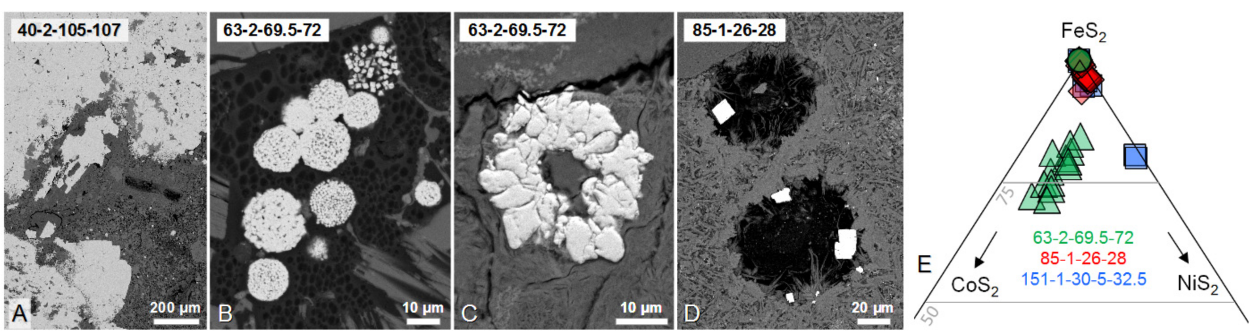

Fig. 1: Scanning electron images (15 kV) of Fe-sulfides in the Chicxulub impactites (Core M0077A). **A**: Blocky pyrite or marcasite; **B**: framboidal pyrite; **C**: Co-Ni-Cu-rich Fe-sulfide; **D**: Ni-bearing pyrite lining impact melt vesicles; **E**: Ternary Fe-Ni-Co end member diagram (50–100 mol % FeS_2 shown) with select analyses plotted. Green circles: framboidal pyrite; triangles: Co-Ni-Cu-rich Fe-sulfide.

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