Preliminary evaluation of trace hydrocarbon speciation and abundance by bulk GC analysis of fluid inclusion volatiles as an exploration tool for footwall-style sulfide ore associated with the Sudbury Igneous Complex, Ontario, Canada

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The North Range of the Sudbury Igneous Complex (SIC) hosts footwall-style Cu-Ni-platinum group element (PGE)-rich sulfide deposits of predominantly magmatic origin but that have been influenced by multiple syn- and post-magmatic hydrothermal events. The composition of reduced carbonic phases (unsaturated and saturated hydrocarbons, C1 to C6) in fluid inclusions within the matrix of Sudbury breccia, a rock unit that is permeable to circulating volatiles and that commonly hosts footwall-style Cu-Ni-PGE deposits, has been investigated by in-

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line rock-crushing gas chromatography. This was done on samples from zones of breccia that are known to contain economic footwall sulfide deposits and zones barren of such deposits. Subtle but strategically significant differences have been found in the composition and abundance of bulk hydrocarbons that are released from mineralized and barren breccias when fluid inclusions are opened. These findings include: (i) statistically higher average abundances of light, saturated hydrocarbons (C1–C4) in mineralized, embayment-associated footwall packages than in breccia from barren environments (maximum difference of approx. half an order of magnitude for propane abundances; mol/g rock); (ii) higher total abundance of hydrocarbons in fluid from mineralized environments ($8.11 \times 10^{-9} \pm 1.91 \times 10^{-9}$ mol/g) than in barren ones ($4.93 \times 10^{-9} \pm 1.53 \times 10^{-9}$ mol/g); and (iii) no statistically significant differences in average unsaturated hydrocarbon abundances between the two breccia environments, but differences are present when considering the spatial variations of hydrocarbons within the mineralized breccia package itself relative to massive sulfide mineralization. Additionally, samples of breccia and quartz (from quartz + sulfide assemblages) from PGE-rich environments significantly deviate from expected hydrocarbon signatures and are considerably more enriched in unsaturated hydrocarbons. These findings strongly suggest that fluid hydrocarbon signatures should be taken into consideration when exploring for Cu-Ni-PGE-rich footwall-style ore bodies as a supplemental criterion to traditional visual and geochemical approaches.