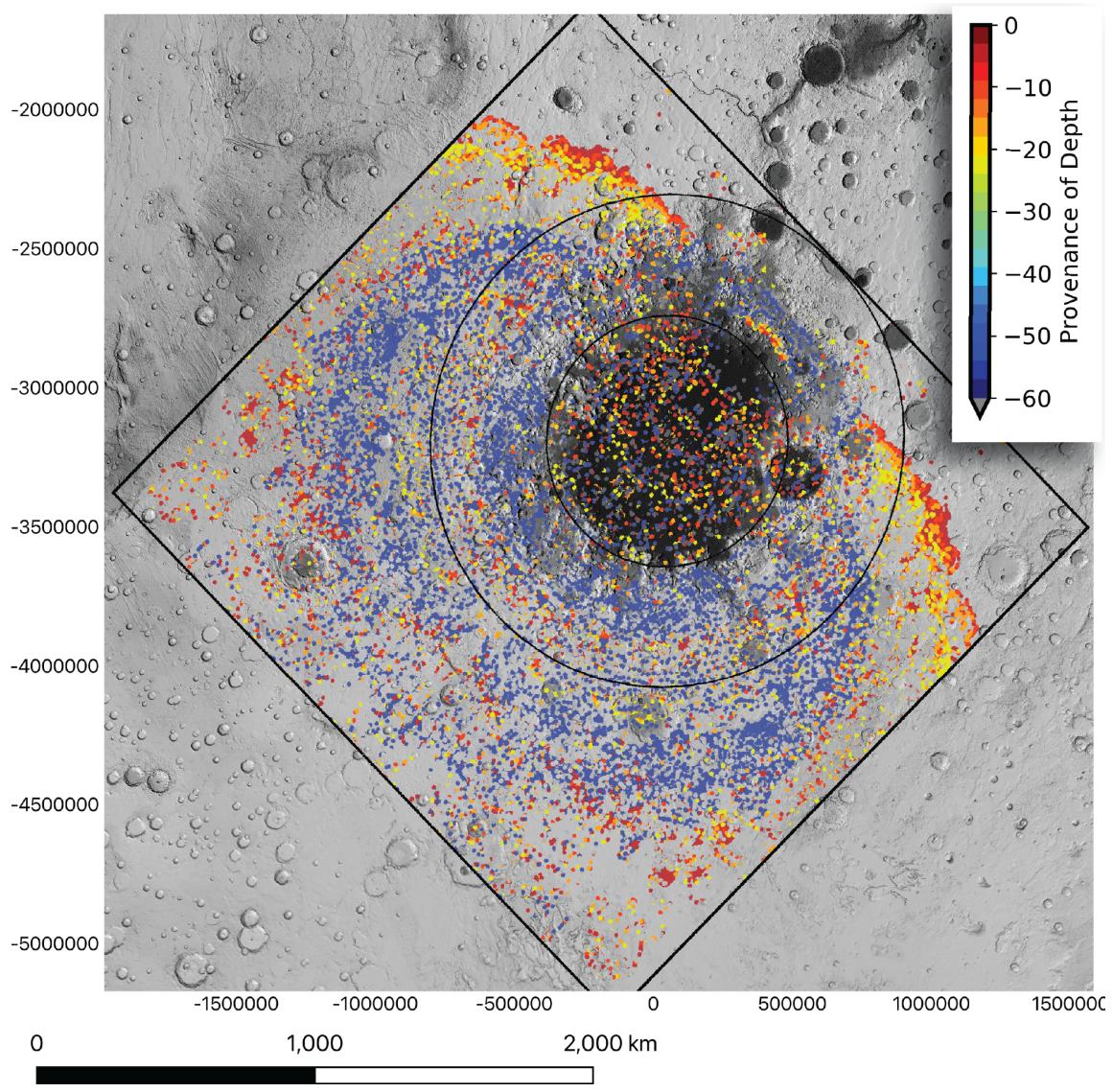
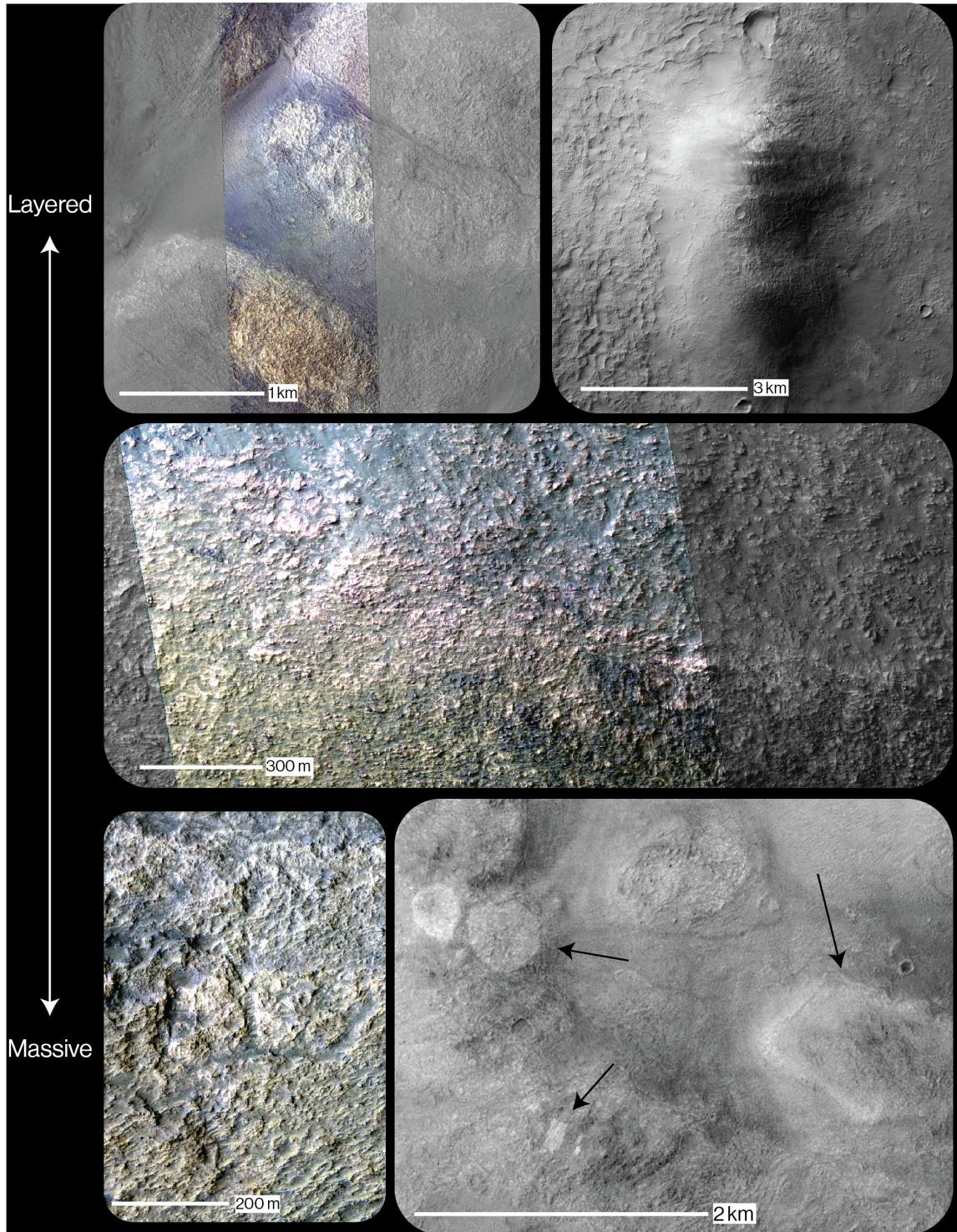


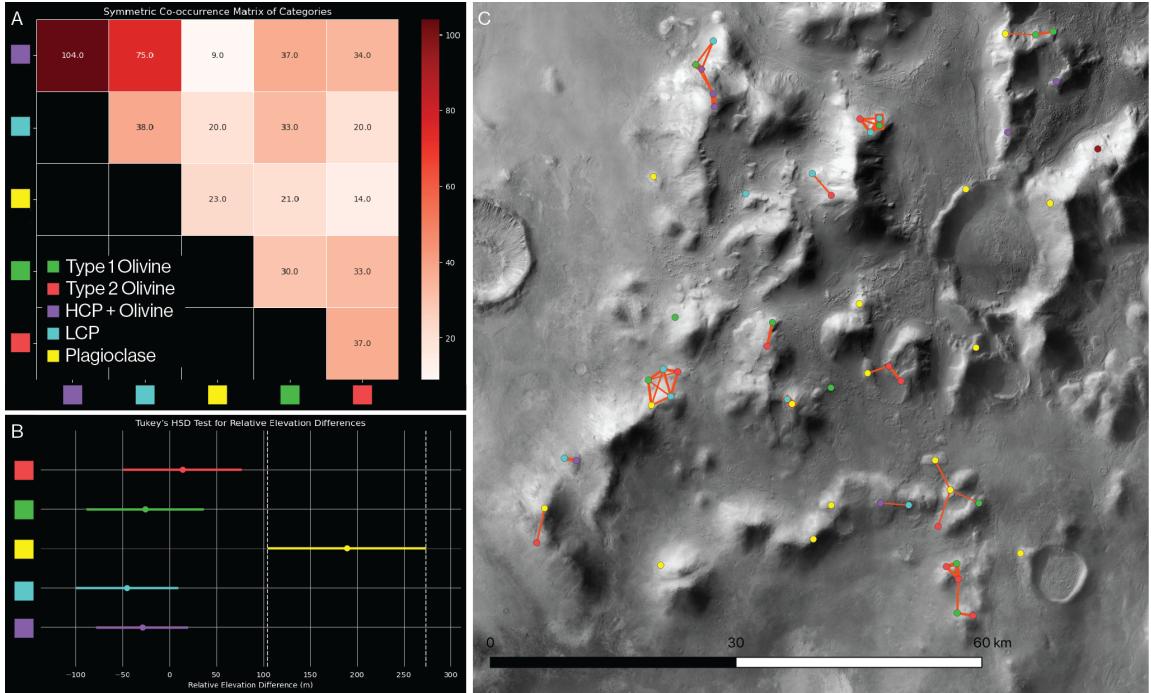
Extended Data Figures



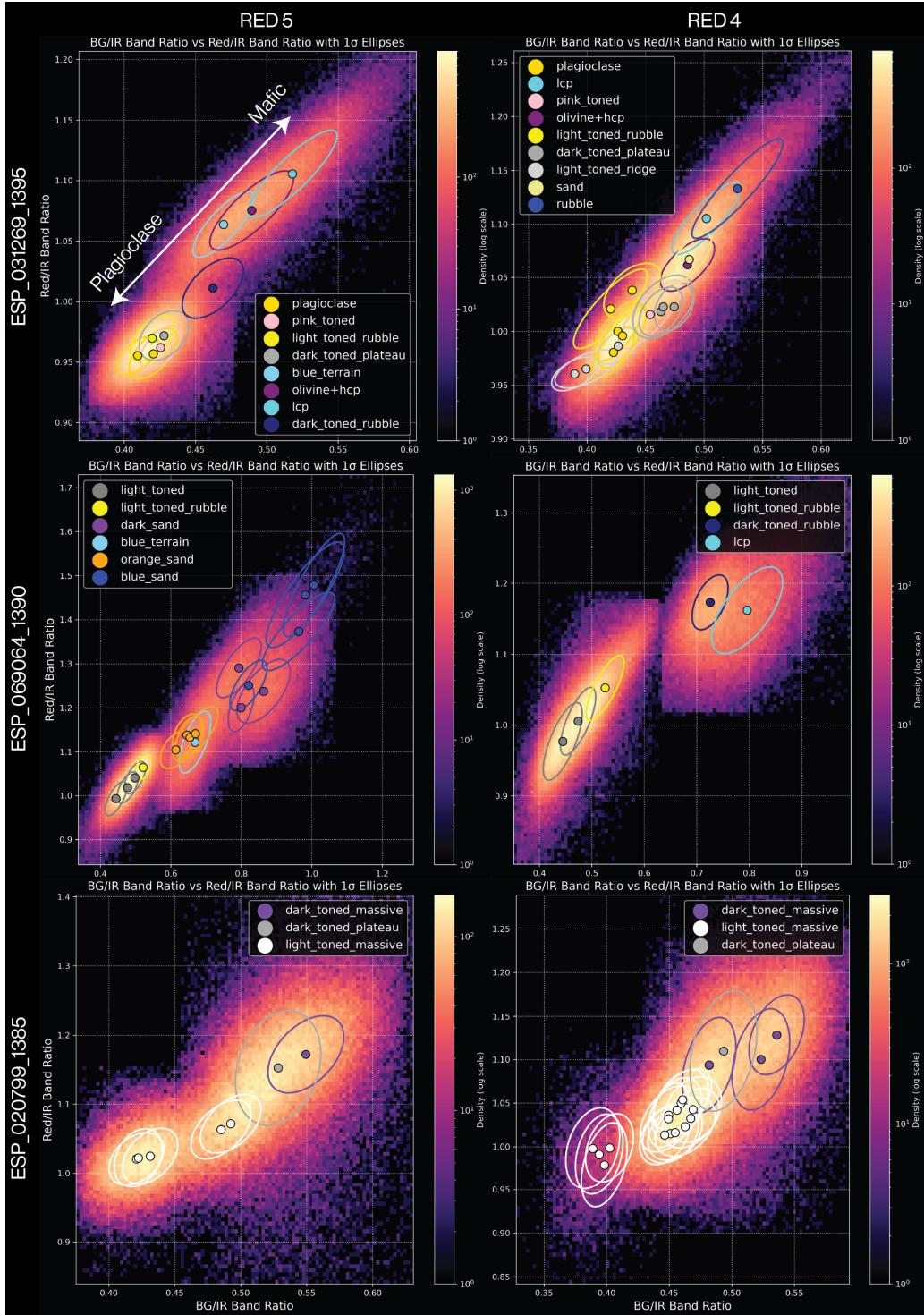
Extended Data Figure 1: Excavation depth of material from an iSALE3D model run for a NE to SW trending impact with an impact angle of 45°. Materials with a deeper provenance are plotted on top of materials with shallower provenance to highlight the extent of excavation of deep material.



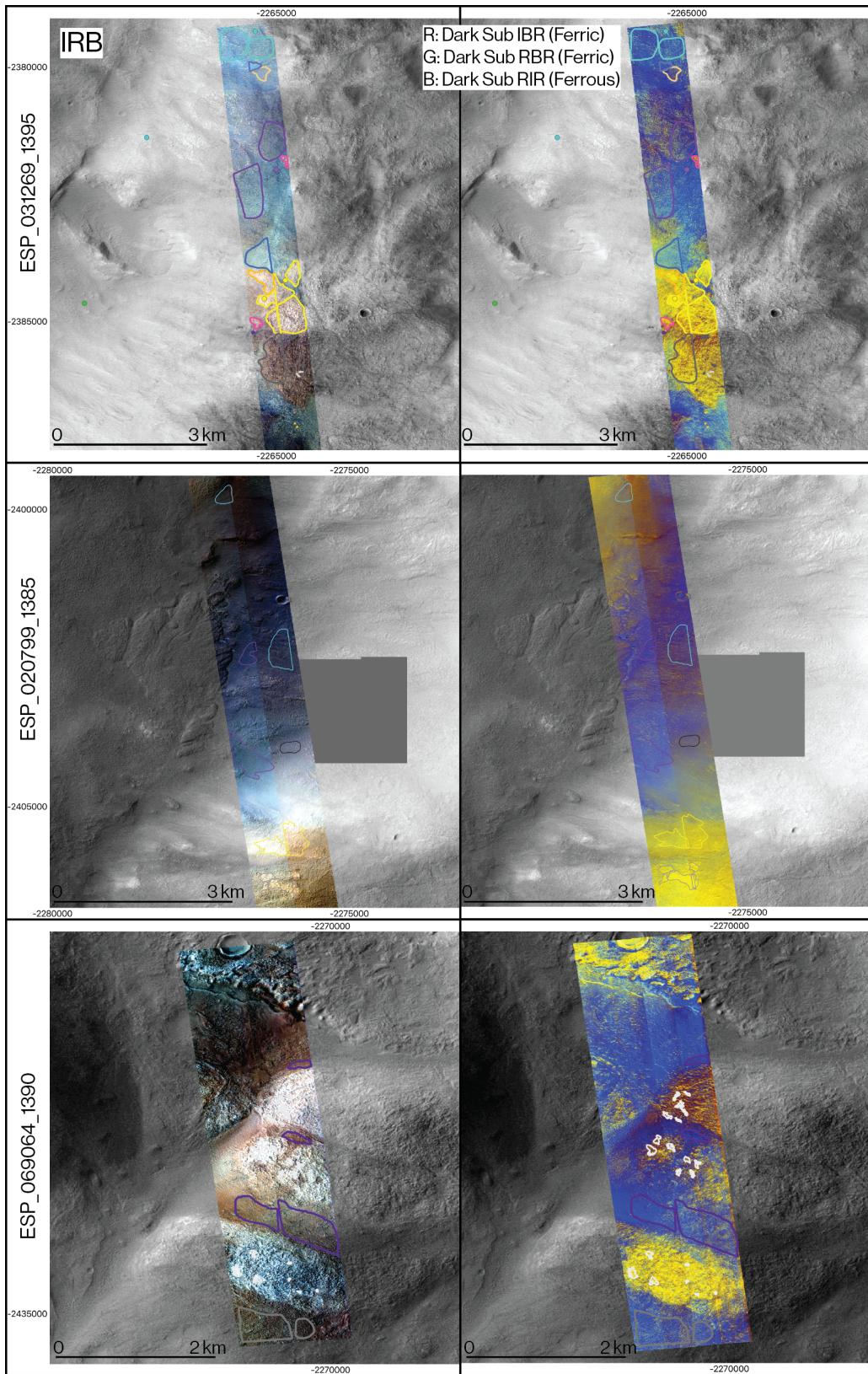
Extended Data Figure 2: Layered and massive textured feldspathic outcrops in HiRISE (top left, middle, bottom left) and CTX images (top right, bottom right). The bottom right CTX image shows an example of "mega breccia" morphology, with both blocky/angular and rounded light-toned blocks surrounded by darker-toned material.



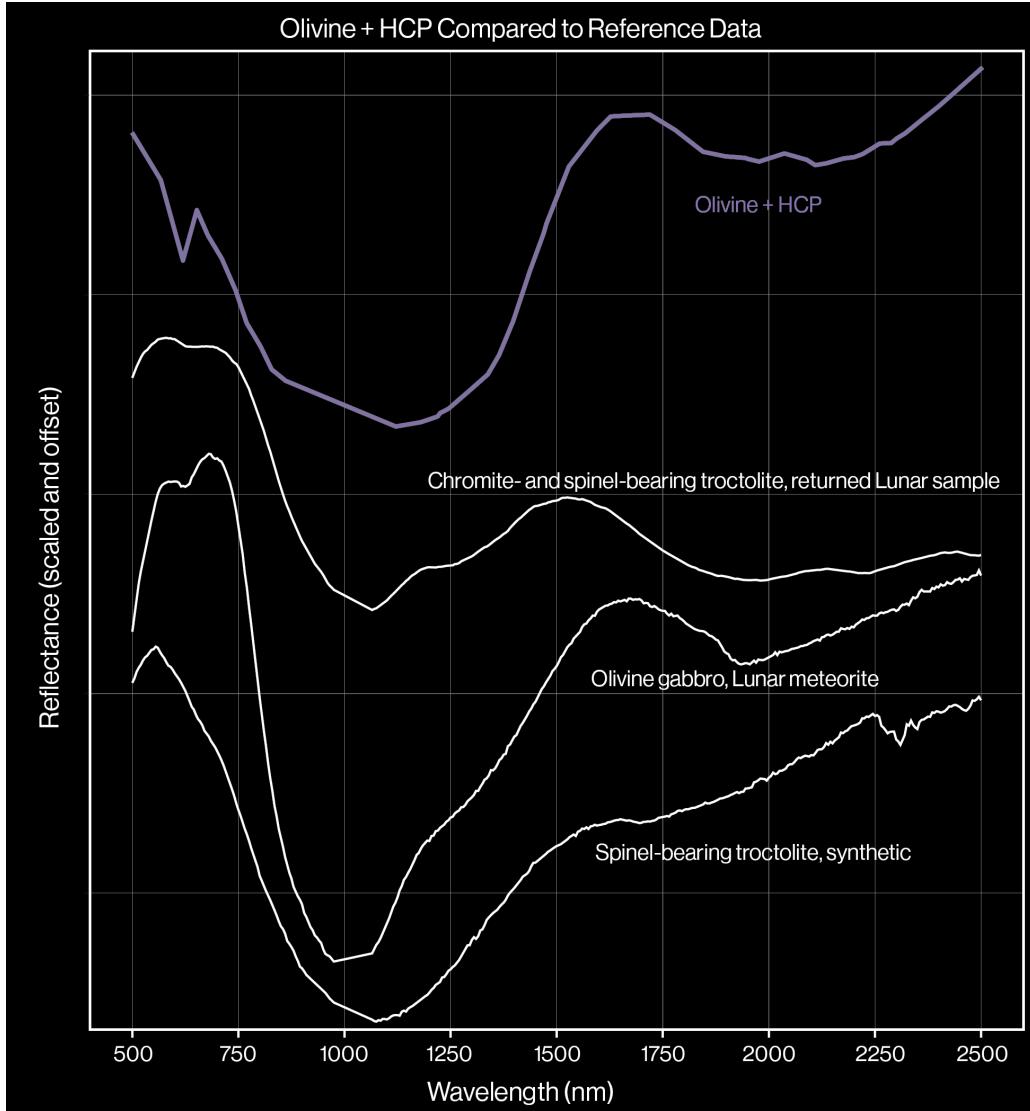
Extended Data Figure 3: Results of a graph network analysis on the local context ($\leq 5\text{ km}$) of primary igneous minerals surrounding the Argyre basin. A) Symmetric Co-occurrence matrix among the 5 categories of interest for this study: olivine + HCP (purple), LCP (cyan), plagioclase (yellow), type 1 olivine (green) and type 2 olivine (red). B) Results from Tukey's HSD test (performed after a one-way ANOVA) showing the relative elevation (x-axis) for each category compared to its neighbors. The 95% confidence intervals (horizontal bars) for each category intersect zero except for plagioclase, which is approximately 200 m above its neighboring outcrops on average. C) Example connections (orange lines) among outcrops (dots) in the graph network. Line thickness is inversely proportional to outcrop distance. Dot colors correspond to the same category colors as in A and B.



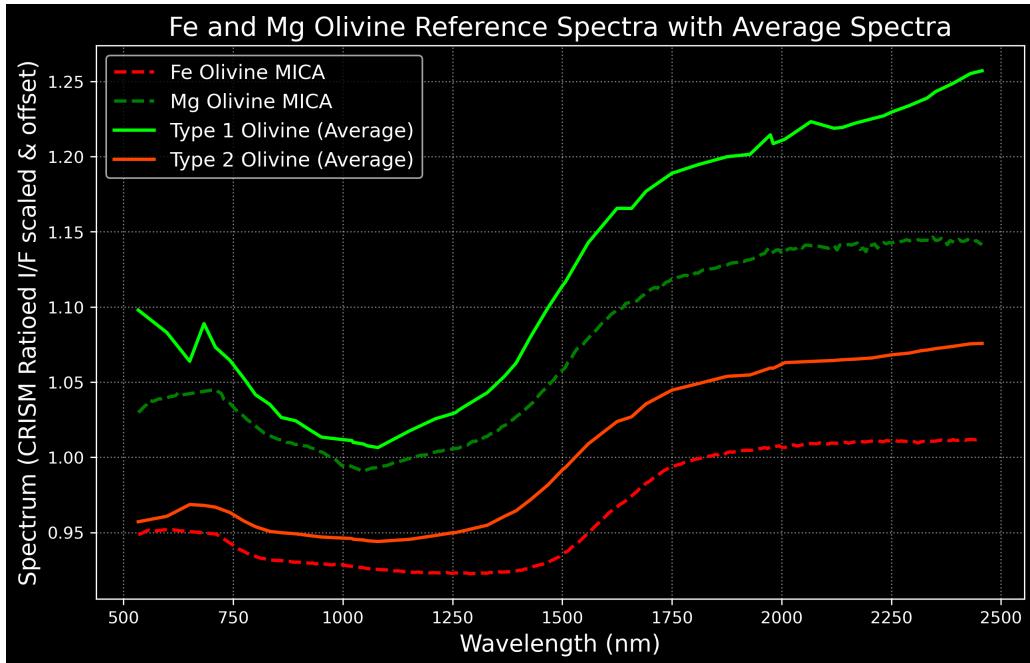
Extended Data Figure 4: Band ratio plots showing high IR/BG and IR/Red ratio values for plagioclase compared to same-scene mafic minerals.



Extended Data Figure 5: HiRISE data and ROIs used to create plots in Extended Data Fig. 3.



Extended Data Figure 6: Comparison of the Olivine + HCP category to library reference data from RELAB. Our categorization label implies the lithology may be lherzolite/wehrelite/gabbro (olivine + high-calcium pyroxene \pm plagioclase; compare to olivine gabbro lunar meteorite spectrum). An alternative interpretation may be chromite or spinel-bearing troctolite compositions (plagioclase + olivine + chromite/spinel). RELAB IDs used for this plot: sa2ls8 (chromite- and spinel-bearing troctolite returned lunar sample), camt313 (olivine gabbro lunar meteorite), and c1jg15 (synthetic spinel-bearing troctolite).



Extended Data Figure 7: Results from Type 1 and Type 2 olivine categorization method. Band center, band depth, slope between 1000 and 1300 nm, full width at half maximum, and band asymmetry were used to categorize the olivine detections. We performed a PCA followed by k-means clustering to assign the category labels. Dashed lines are MICA library "Mg" (green) and "Fe" (red) spectra, which correspond to Type 1 and Type 2 olivine respectively. Solid lines are the average spectra for each category attained after PCA and k-means.