Supplementary Materials: Ultramafic Alkaline Rocks of Kepino Cluster, Arkhangelsk, Russia: Different Evolution of Kimberlite Melts in Sills and Pipes

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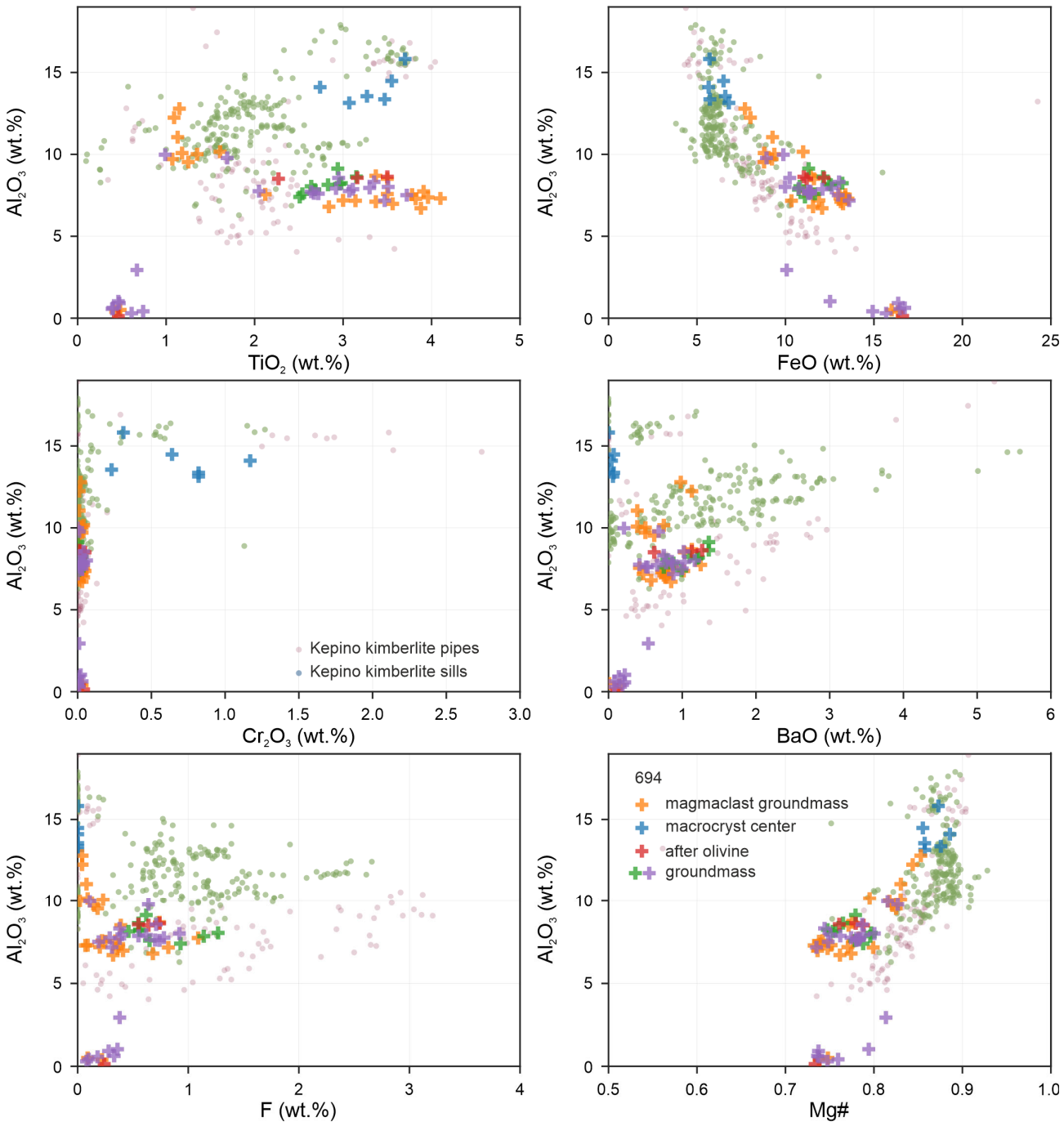

Figure S1. Bivariate plots for the phlogopite from the Kepino kimberlite pipe 694 (Kluchevaya).

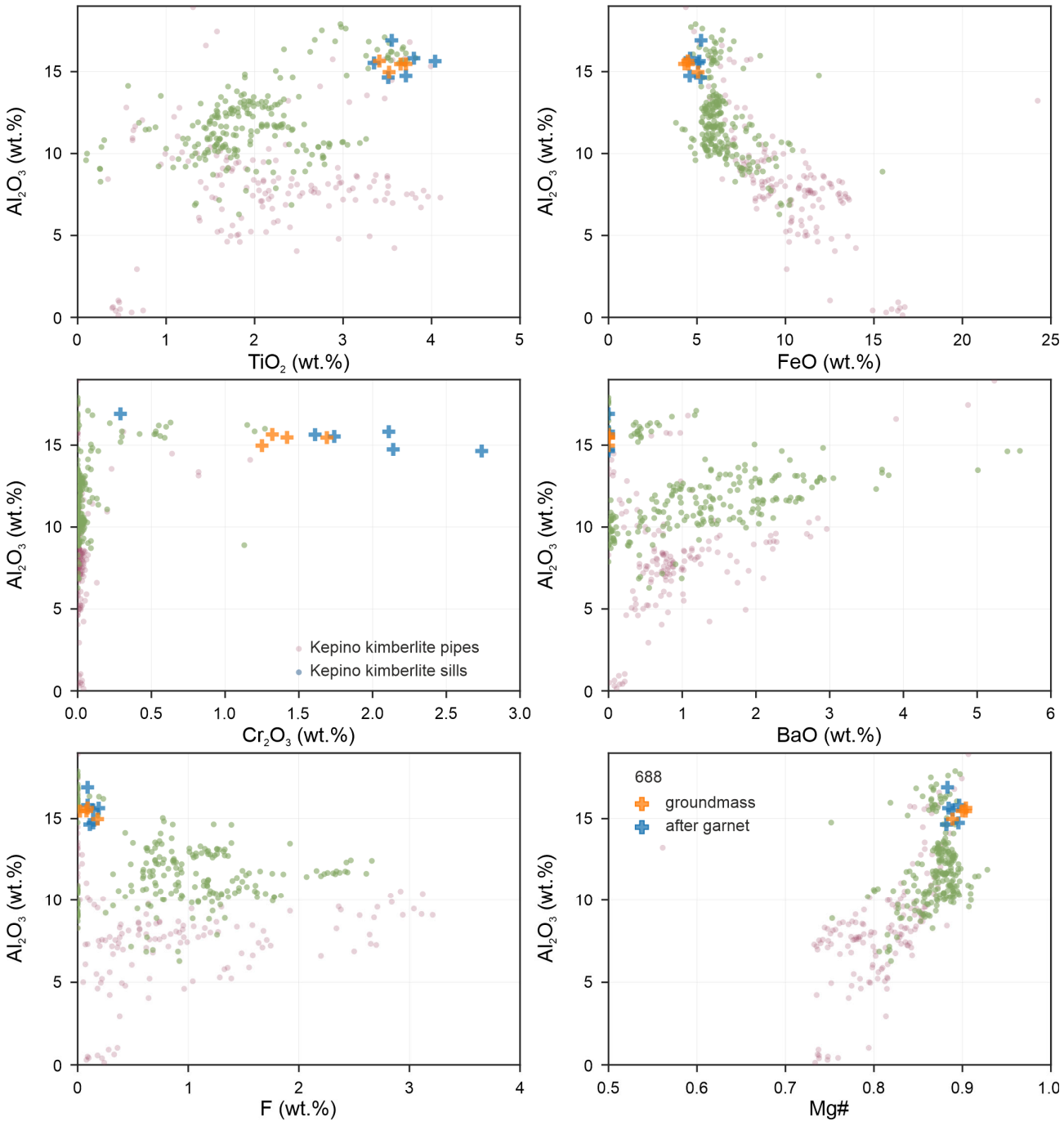

Figure S2. Bivariate plots for the phlogopite from the Kepino kimberlite pipe 688.

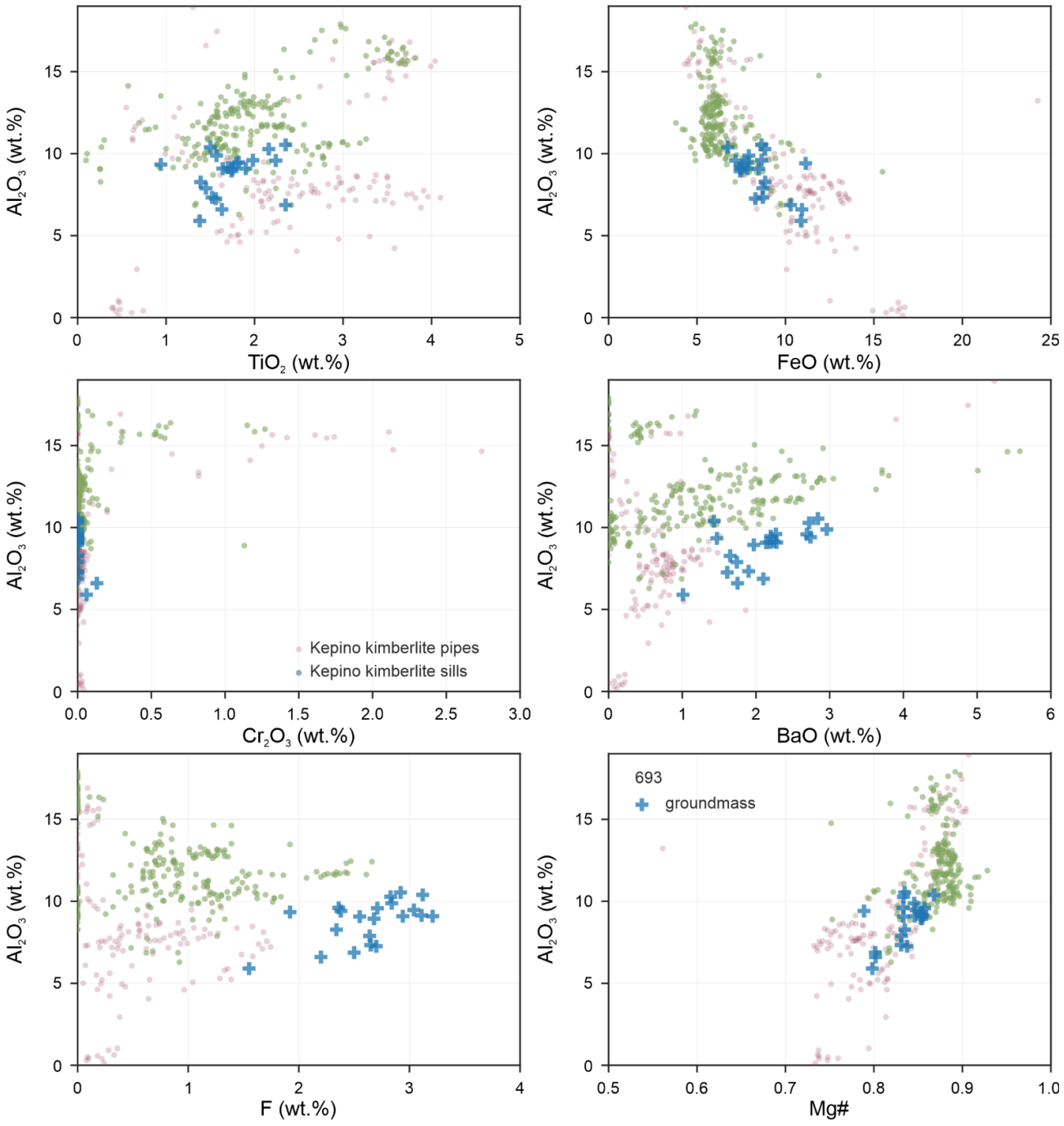

Figure S3. Bivariate plots for the phlogopite from the Kepino kimberlite pipe 693.

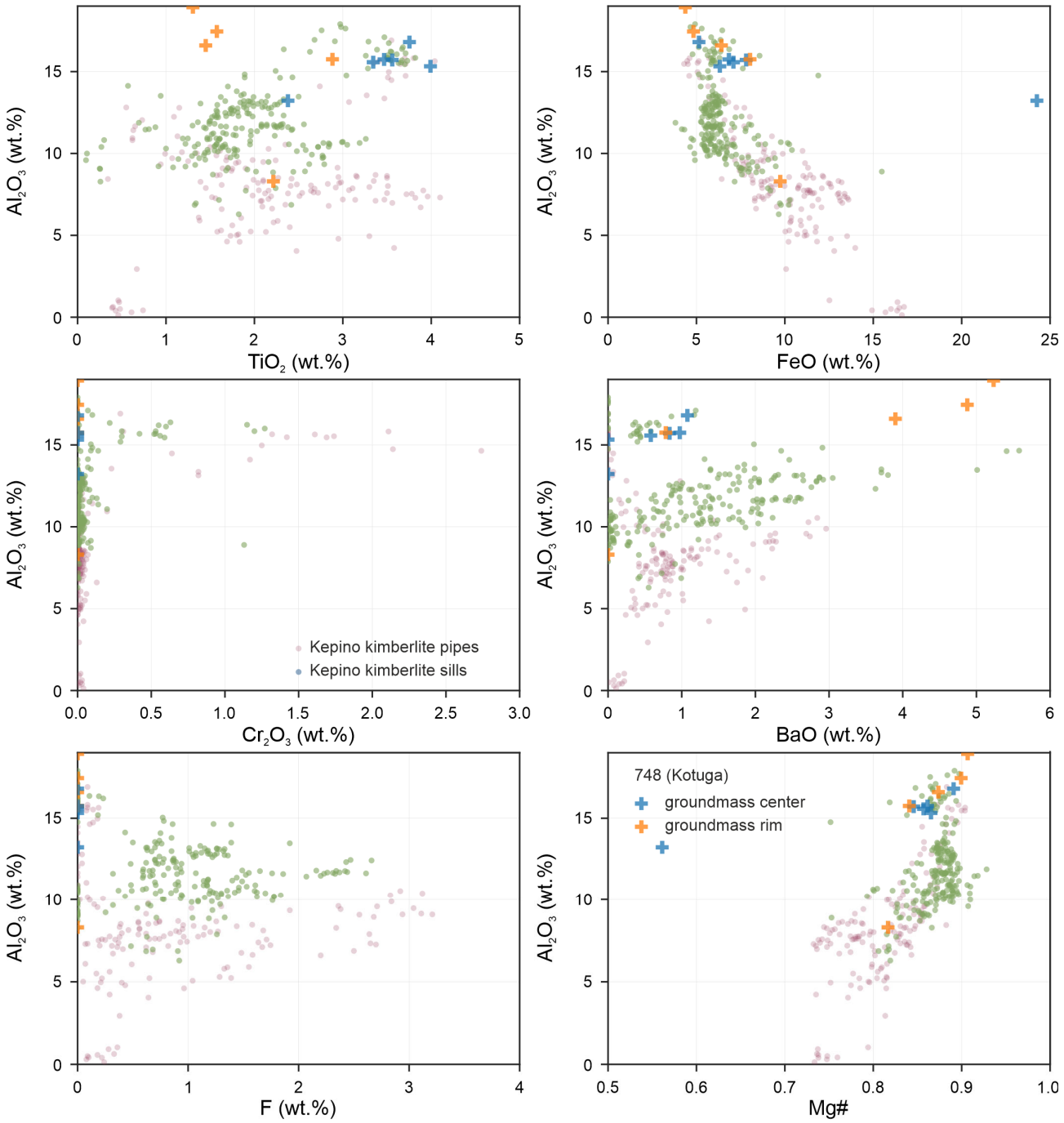

Figure S4. Bivariate plots for the phlogopite from the Kepino kimberlite pipe 748 (Kotuga).

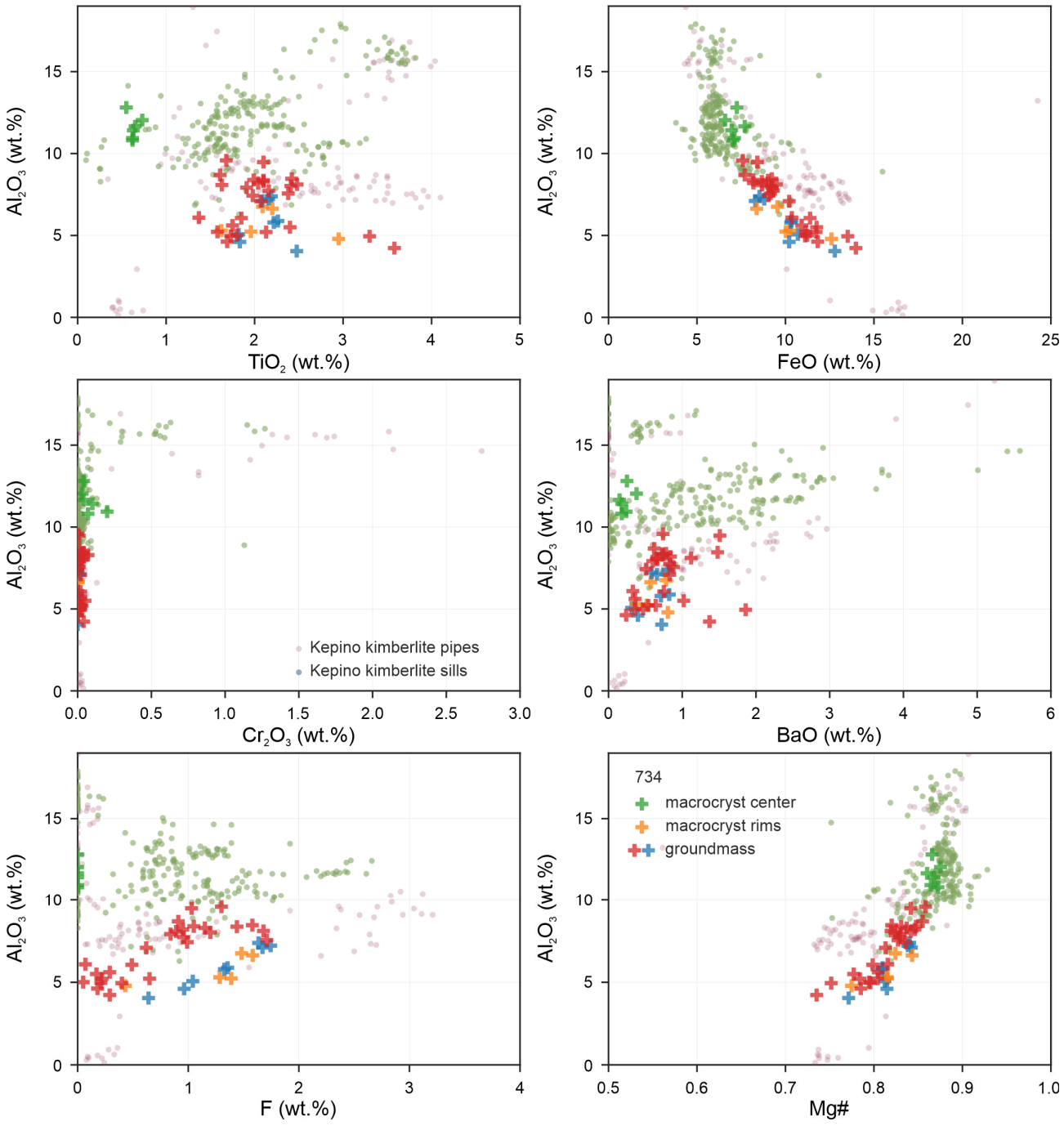

Figure S5. Bivariate plots for the phlogopite from the Kepino kimberlite pipe 734.

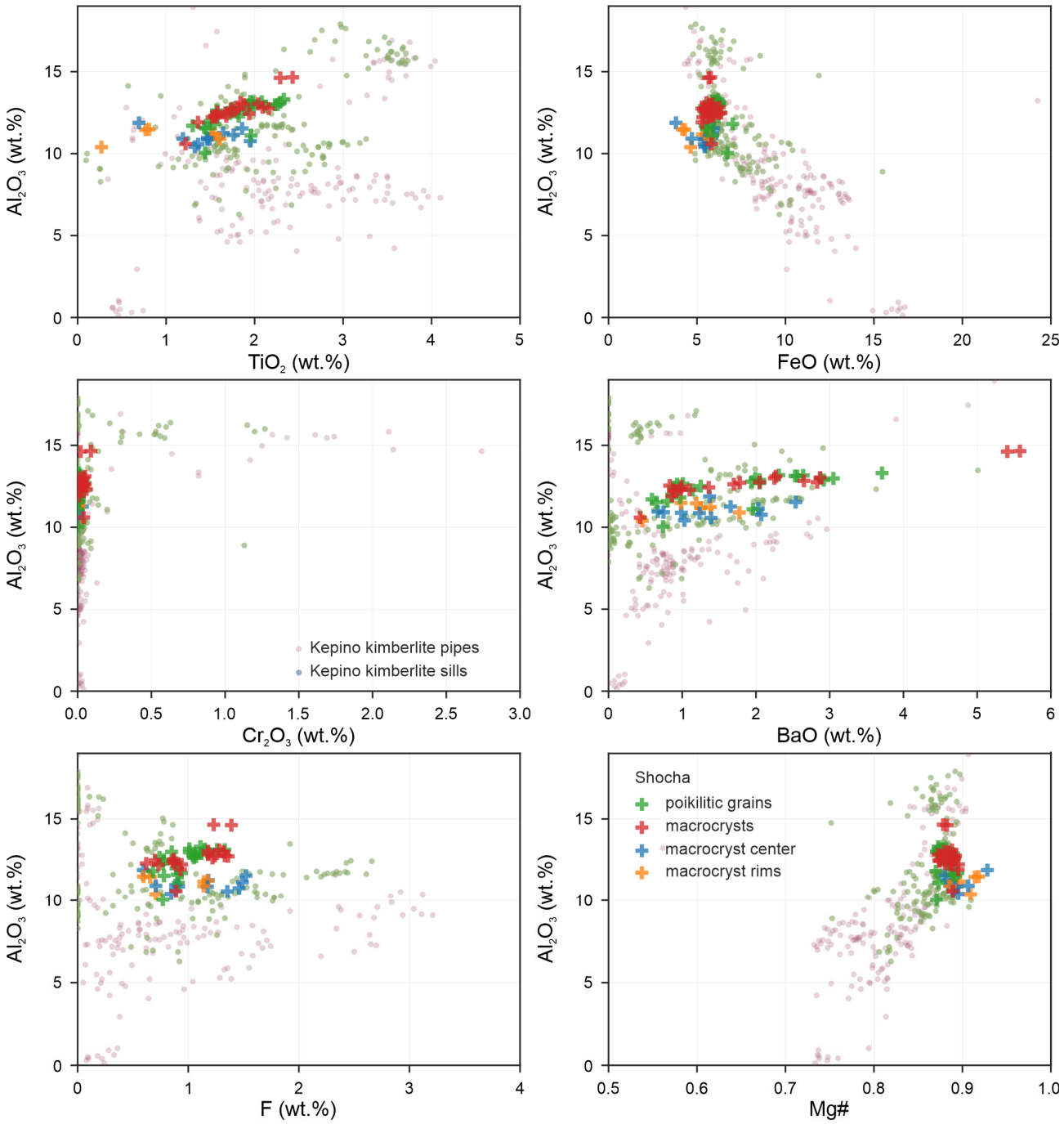

Figure S6. Bivariate plots for the phlogopite from the Kepino kimberlite sill 136a (Shocha).

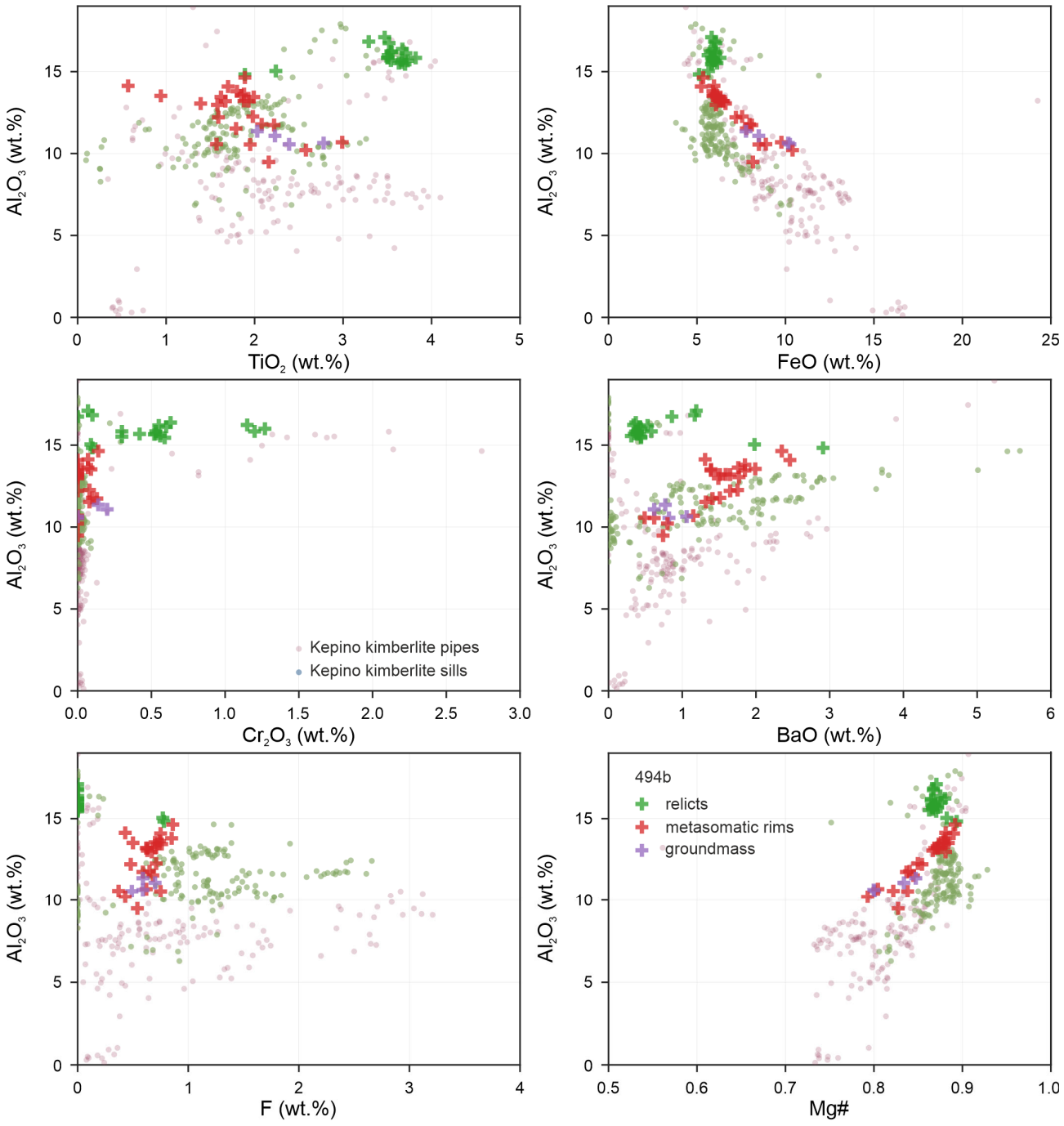

Figure S7. Bivariate plots for the phlogopite from the Kepino kimberlite sill 494b (Zvezdochka).

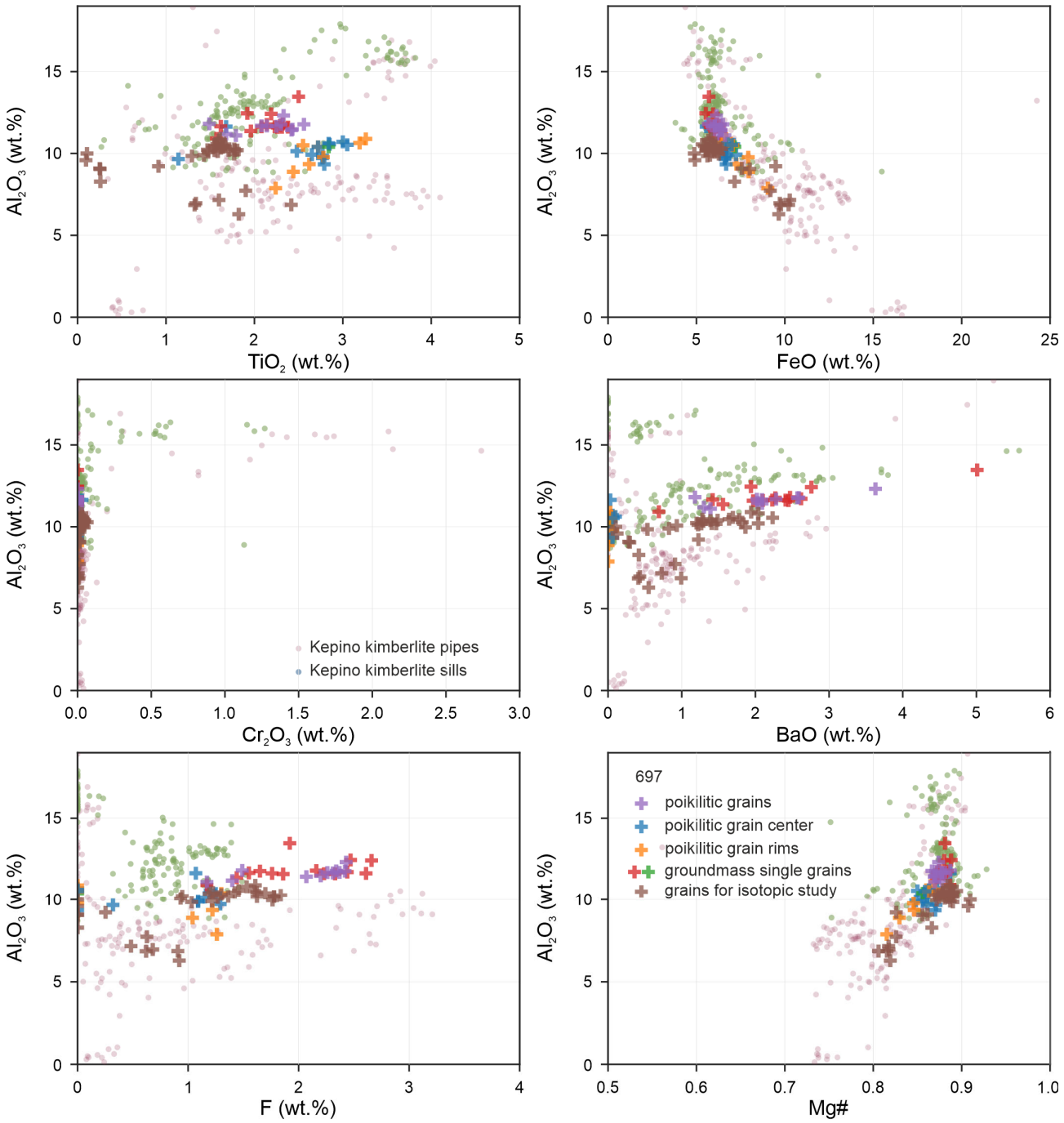

Figure S8. Bivariate plots for the phlogopite from the Kepino kimberlite sill 697.

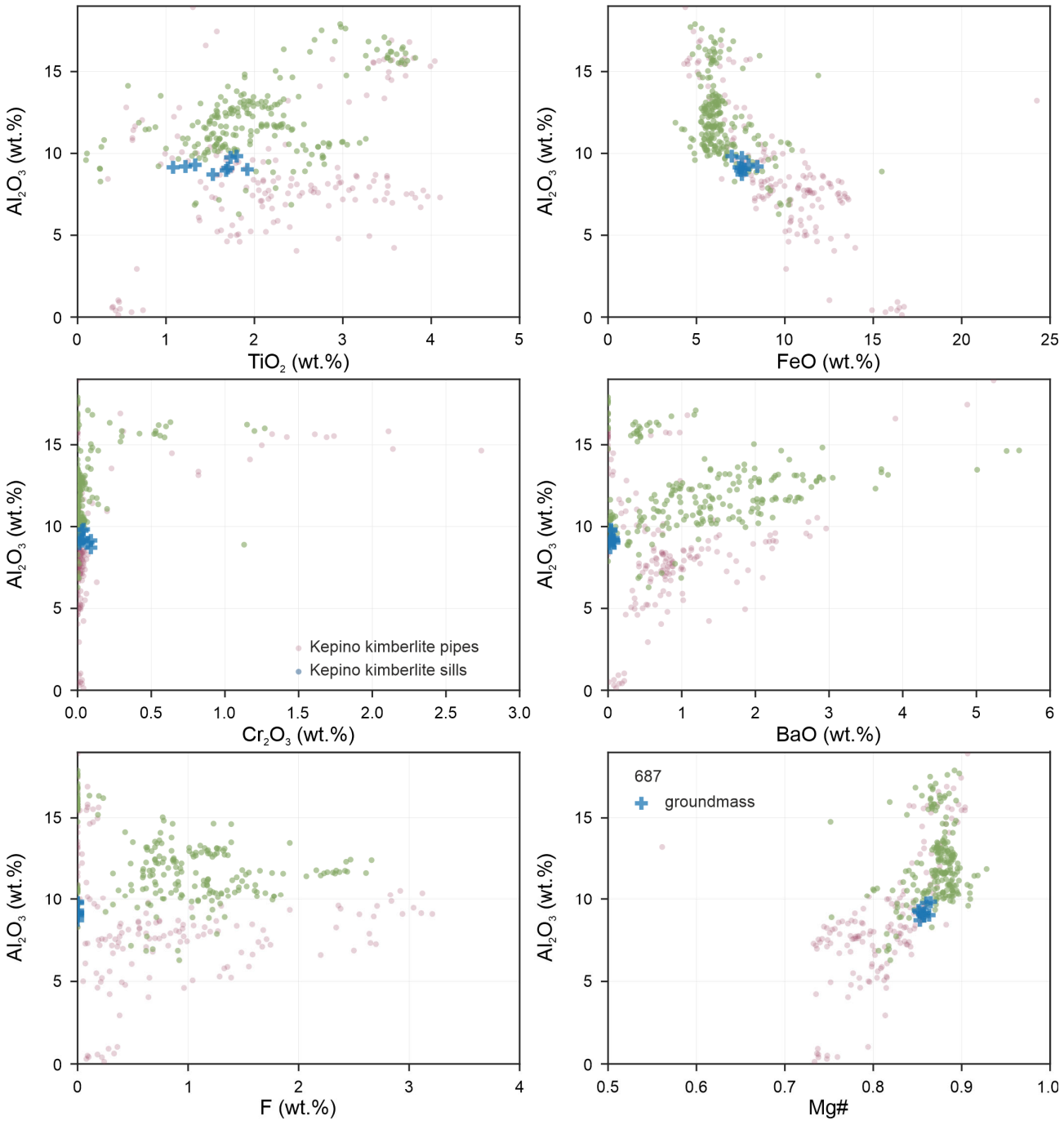

Figure S9. Bivariate plots for the phlogopite from the Kepino kimberlite sill 687.

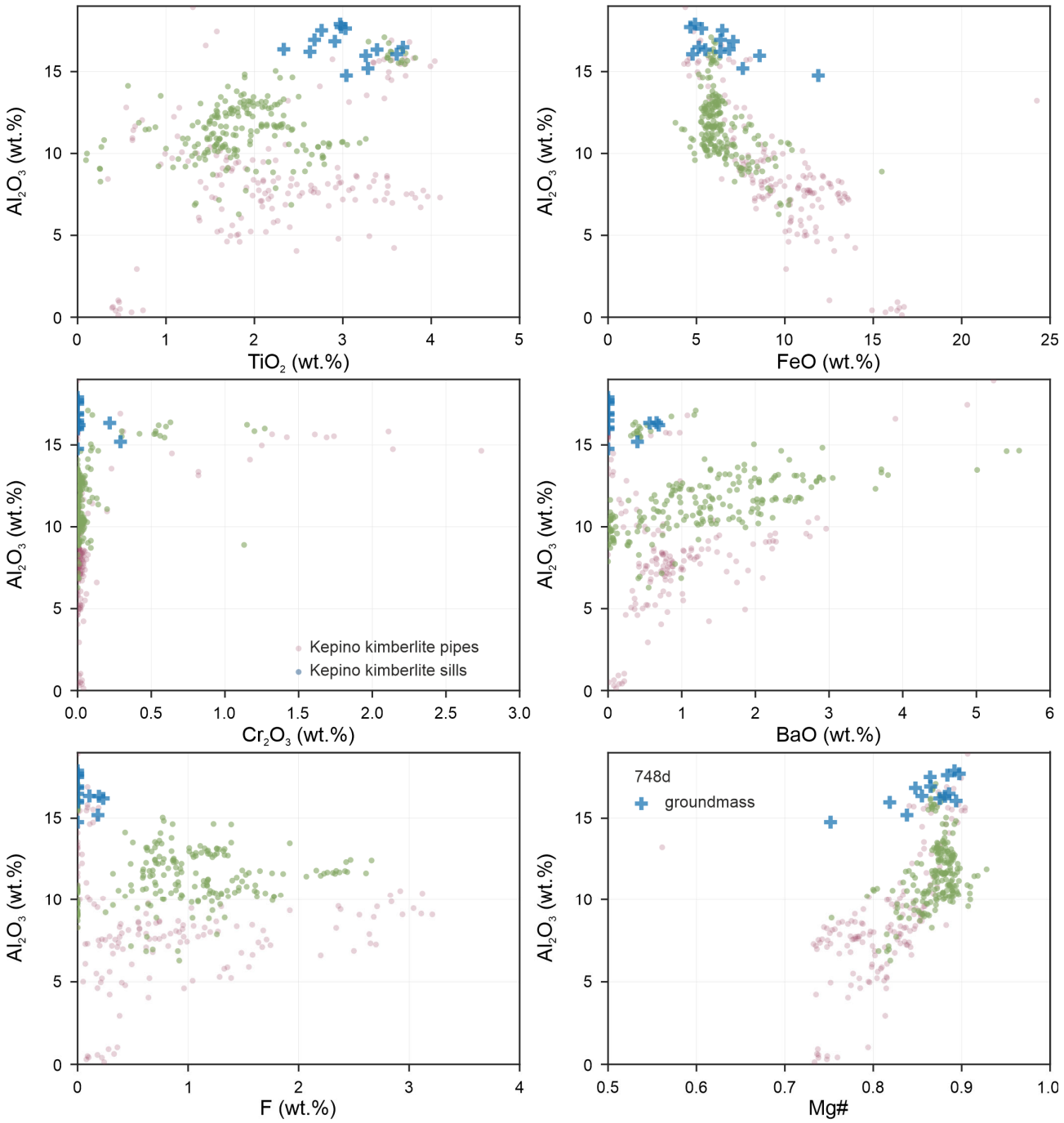

Figure S10. Bivariate plots for the phlogopite from the Kepino kimberlite sill 748d (Kotuga).

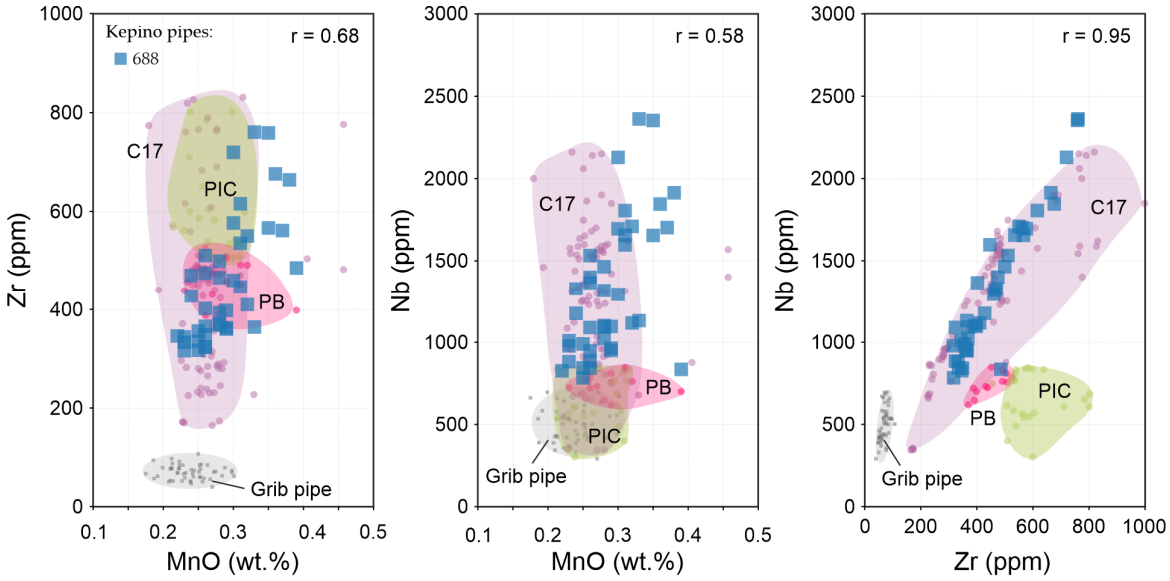

Figure S11. Bivariate plots for ilmenite from the Kepino cluster kimberlite (sample 688). The field "Grib pipe" is for ilmenite megacrysts and ilmenite from mantle-derived xenoliths from the Grib kimberlite, ADP, based on [1]. The fields "PIC" and "PB" are for ilmenite from phlogopite–ilmenite–clinopyroxene (PIC) and polymict breccias (PB) mantle xenoliths from the South Africa kimberlites [2,3]. The field "C17" is for ilmenite nodules from Catoca kimberlite, Angola, based on [4].

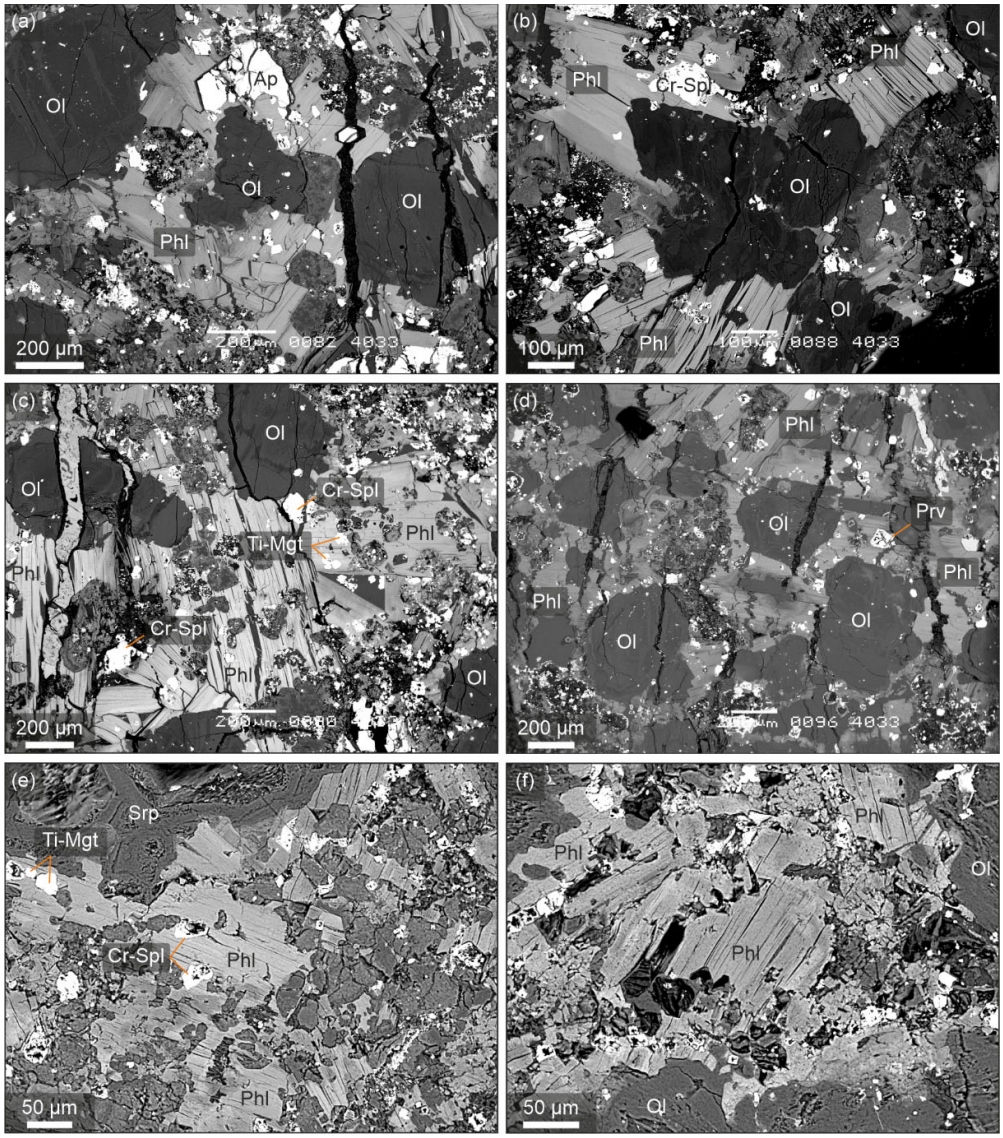

Figure S12. BSE images of coherent porphyritic kimberlite from the Kepino sill 697: kimberlites have a porphyritic texture (Figure 4a) and are composed of olivine (Ol) macrocrysts (10 vol.%) and phenocrysts (45–50 vol.%) set in a kimberlite groundmass (40–45 vol.%). The olivine macrocrysts are rounded to angular and vary in size up to 15 mm. Olivine phenocrysts have isometric, euhedral, and subhedral shapes and are 0.1–1.0 mm in size. The olivine is fully altered to serpentine. The kimberlite groundmass has a granular texture and consists of phlogopite (Phl), spinel (Cr-Spl), titanomagnetite (Ti-Mgt), apatite (Ap), perovskite (Prv), serpentine (Srp) and carbonate. Phlogopite occurs as poikilitic grains within kimberlite groundmass rarely as discrete slightly elongated phenocrysts (<500 µm). Poikilitic phlogopite contains inclusions of titanomagnetite and spinel as well as irregular serpentine inclusions (**a–c**) and can reach a size of 1 mm. The value of poikilitic inclusions varies in the wide range from the first to 35–40 vol.% of the crystal. Sometimes the phlogopite "cemented" olivine phenocrysts partly replace olivine (**d**). No secondary phases like chlorite altered the phlogopite. For isotopic studies, we have separated phlogopite from kimberlite varieties where the volume of poikilitic inclusions is minor (**e–f**). Phlogopite separated for isotopic study is characterised by intermediate concentrations of Al_2O_3 (~10 wt.% hereinafter the median value, n = 33), TiO_2 (1.6 wt.%), FeO (6 wt.%), low of concentrations Cr_2O_3 (0.01 wt.%), F (1.2 wt.%), and BaO (1.3 wt.%) with Mg# value = 0.88, corresponding with the most common composition of phlogopite from the Kepino kimberlite sills (Figure S8). Also, studied phlogopites show evolution toward tetraferriphlogopite (i.e., Al depletion and Fe enrichment) for phlogopite from rim zones. The phlogopite composition suggests no evidence of secondary alteration and corresponds to the composition of phlogopite crystallised from ultramafic alkaline magmas (see the main text).

References

1. Kargin, A.V. V.; Nosova, A.A.A.; Sazonova, L.V. V.; Peresetskaya, E.V. V.; Golubeva, Y.Y.Y.; Lebedeva, N.M.M.; Tretyachenko, V.V. V.; Khvostikov, V.A.A.; Burmii, Z.P.; Burmii, J.P. Ilmenite from the Arkhangelsk Diamond Province, Russia: Composition, Origin and Indicator of Diamondiferous Kimberlites. *Petrology* **2020**, *28*, 315–337, doi:10.1134/S0869591120040050.
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