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Novel $(NH_4)_2HPO_4$–$LiBO_2$ fusion technique for bulk silicate rock analysis by laser ablation-inductively coupled plasma-mass spectrometry

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Laser ablation–inductively coupled plasma mass spectrometry (LA-ICP-MS) is a reliable and robust tool for multielement analysis in geological samples owing to its minimal sample preparation, high sensitivity, and ability to directly microsample solids. However, when it comes to bulk analysis, LA-ICP-MS faces limitations due to small sampling volumes and the inherent heterogeneity of geological samples, which can compromise data quality. Therefore, preparation of homogeneous and mechanically resistant targets is essential for representative bulk analysis by LA-ICP-MS. Fused glasses are preferred (for LA-ICP-MS) over pressed powder pellets owing to their greater homogeneity. However, their use is often limited by the loss of Pb and Zn during the fusion process. In this study, a novel and rapid $(NH_4)_2HPO_4$–$LiBO_2$ fusion technique using a homemade fusion furnace and graphite crucibles was established for determining major and trace elements in silicate rocks by LA-ICP-MS. Homogenous glasses were produced by fusing a mixture of ~50 mg of silicate rock powders, 10 mg of $(NH_4)_2HPO_4$, and 100 mg of $LiBO_2$ at 950 °C for 5 min in a closed fusion system. This approach ensures the complete dissolution of refractory minerals such as zircon and effectively suppresses the loss of volatile elements such as Pb and Zn. The use of a 100% oxide normalization calibration strategy provided accurate results, enabling the direct analysis of unknown samples without any prior determination of internal standard element mass fractions. Analytical results for most elements in five silicate rock reference materials generally agreed with the reference values, within 10% deviation. Precision was achieved within 5% relative standard deviation (RSD) for major elements and 10% RSD for most trace elements. The developed method is simple, rapid, and efficient, addressing the challenges of volatile element loss and incomplete dissolution of refractory minerals, which significantly benefits the application of LA-ICP-MS for bulk silicate rock analysis.