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Exploring the benefits of combining LIBS and LA-ICPMS for geological based applications

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For most geological applications elemental content and isotopic information can be quickly obtained by ICPMS or MC-ICPMS with relatively good precision. However, ICPMS is not routinely able to detect key stoichiometric components such as H, N, O, and F due to atmospheric or argon-based plasma conditions, respectively. In the case of F, the argon-based plasma does not have sufficient ionization potential to ionize fluorine. Due to these reasons, researchers will use various instruments to obtain all the information needed to characterize their samples. Popular techniques such as secondary ion mass spectrometry (SIMS) can be used for F, Cl, and S and electron probe microanalysis (EPMA) can obtain information about elements such as P, Si, Fe, Mg, Ca, Na, S, F, and Cl. EPMA is typically a slower technique in terms of data collection relative to ICPMS. In addition, it has poor sensitivity for rare earth elements (REEs), whereas, ICPMS is extremely sensitive for REEs. Laser-induced breakdown spectroscopy (LIBS) offers the ability to detect every element on the periodic table, including elements that are difficult to detect by ICPMS such as F, H, N, and O. LIBS can be combined with laser ablation (LA)-ICPMS, providing a single fast analytical technique to cover the entire periodic table with a wide dynamic range. Here, we explore the use of simultaneous LIBS and LA-ICPMS for the characterization and quantification of geological samples using known apatite samples. LIBS provides elemental information for elements such as F, O, H, Na, Ca, Mg, Si, P, Mn, and Al, whereas, LA-ICPMS provides elemental and isotopic information for dating by Pb, Th, and U.