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Modern techniques for monitoring flow units in the ignimbrite sequences from Central Anatolia (Turkey): μ-XRF, CRS and GPR methods

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Ignimbrites are deposits resulting from the eruption of volatile-rich silicic magma and represented the main lithology of pyroclastic products. They can be spread out to tens to thousand cubic kilometers during single or multiple eruptions. The widespread ignimbrite outcrops don't exhibit lateral changes, whereas vertical changes are not easily distinguishable. This may cause to identify the same ignimbrite series with different definition. The Central Anatolia of Turkey contains well-preserved volcanic structures and voluminous ignimbrite outcrops to test the new methods for determining their eruption histories. The well-welded Incesu ignimbrite has a wide distribution in the Central Anatolia. It is possible to identify three levels (Lower Level, Medium Level, Upper Level) separated by different color, texture, and structural features. LL shows blackish brown in color and glassy, strongly to very strongly welded, non-jointed, mostly massive structure. Well-welded ML is reddish pink in color, moderately to strongly welded, vertically fractured structure. ML has high amount of fiammes. UL of the ignimbrite has pale grey-pinkish gray in color, fine grained, poorly welded, friable and vertically jointed. It has high amount of pumice and rock fragments with different composition. The mineralogical composition of the Incesu ignimbrite is composed of plagioclase (oligoclase, andesine) + pyroxene (augite, enstatite) + opaque minerals and less amount of amphibole biotite and quartz. The Incesu ignimbrite has andesite/basaltic andesite composition and medium-high K calcalkaline, peraluminous nature. Its geochemical properties reflect subduction related magma derived from Ocean Island Basalt (OIB) like magma. Ground Penetration Radar (GPR) studies were carried out to support the geological and petrographically determined differences. The GPR is a new geophysical application and quite useful in the determination of lithological changes within the pyroclastic successions. In this study the processed data of GPR measurements show that the Incesu ignimbrite has composed of 3 different levels and each level has different electromagnetic properties (Figure 1). To provide a better understanding of color change within the Incesu ignimbrite, new research tools that combine μ-XRF and Confocal Raman Spectrometry (CRS) were utilized. The μ-XRF results demonstrated that there are a clear rapid increase of K and slightly Fe intensities within the matrix of the LL relatively to the ML (Figure 2). The high concentration of K and slight concentration of Fe may cause to change the color of the LL to dark brown-black. The CRS studies reveal that the matrix of the LL and ML was composed of anorthoclase and volcanic glass, respectively (Figure 3). As conclusion, Incesu ignimbrite composes of LL, ML and UL. This result is supported by geological and petrographical, GPR, μ-XRF and CRS studies. In addition, this study has presented successful applications of the optical microscopy, GPR, μ-XRF, CRS to the determination of vertical changing in ignimbrite flow unit.

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