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Comparison between PGAA and ID-AMS analysis for determining chlorine content in whole rock basalt

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Accurate determination of chlorine concentrations in terrestrial rocks is of importance for the interpretation of terrestrial in-situ cosmogenic 36Cl. Neutron capture by 35Cl, together with production from Ca and K, is one of the three major production pathways of 36Cl in rocks. Here, we present an inter-comparison of chlorine determinations by two procedures. The first approach is an independent Cl determination by prompt gamma (neutron) activation analysis (PGAA). The second method is isotope dilution based on isotopically-enriched stable chlorine carrier added during chemical sample preparation for accelerator mass spectrometry (ID-AMS). Twenty six (26) whole rock samples have been processed for PGAA and ID-AMS analyses. Elemental analysis by PGAA provides concentrations of major, minor and trace elements including the target elements for 36Cl production (K, Ca, Ti, and Fe), as well as of neutron absorbers and neutron moderators (H, B, Cl, Sm and Gd). The Cl concentrations determined during this study constitute the first inter-comparison for concentrations below 100 μCl/g. Our results show no significant difference in Cl concentrations between methods, and comparable uncertainties. This agreement guarantees that during the procedure we employ for whole rock sample no significant loss of stable chlorine from either the spike or the sample occurs before isotopic equilibration, prior to AgCl precipitation. Furthermore, we show that the elemental analysis by PGAA offers anadvance for the interpretation of 36Cl measurements. It allows simultaneous measurement of major and most trace element concentrations with a precision necessary for calculating the relative contributions to 36Cl production rates of the different mechanisms. Finally, the Cl concentration can be used to optimize the amount of isotopically-enriched spike for AMS-ID sample preparation for 36Cl.