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$^{40}Ar/^{39}Ar$ Geochronology of Terrestrial Pyroxene

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With the advancement of mass spectrometers the ability to obtain robust geochronological data and to precisely date rocks is more important than ever. Felsic rocks have a plethora of minerals that have been developed as viable candidates for varying methods of geochronology analyses (e.g. $^{238}U/^{206}Pb$ dating of zircon and baddeleyite; $^{40}Ar/^{39}Ar$ dating of sanidine and biotite). Mafic rocks, however, and in particular ultramafic rocks, suffer from a lack of mineral types available for geochronology. Currently plagioclase is the common mineral utilized for crystallization ages for continental flood basalts. Plagioclase unfortunately alters into a high K micatious mineral (sericite) as well as completely lacking in ultramafic rocks. Pyroxene is an abundant and essential mineral found in all mafic and ultramafic rocks that often times is more resilient from alteration than plagioclase. Therefore, the ability to date pyroxene would be particularly useful for dating volcanic flows that, although constituting the bulk of large igneous provinces, are naturally devoid of zircon and can be inaccessible if plagioclase has been altered.

The viability of using the $^{40}Ar/^{39}Ar$ technique on the mineral pyroxene is tested using mineral separates from dolerites collected from two different large igneous provinces (LIPs) located in Australia (the Tasmanian Dolerites of the Ferrar LIP and the Kalkarindji LIP). Using the ARGUS VI mass spectrometer, we show that pyroxene can provide meaningful and relatively precise ages, even when plagioclase failed and the rock is altered. Results from this study return ages that are statistically the same as high precision plagioclase $^{40}Ar/^{39}Ar$ plateau ages from the same samples (e.g. TAS-$17_{plagioclase}$: 182.2 ± 0.4 Ma; TAS-$17_{pyroxene}$ 182.1 ± 0.7 Ma) as well as with all previous geochronological results from a variety of other methods (e.g. plagioclase $^{40}Ar/^{39}Ar$ geochronology; U/Pb results from zircon and baddeleyite). These results open up unprecedented geochronological opportunities to all LIPs, ultramafic rocks, drudge rocks, and potentially metamorphic geochronology and thermochronology applications.