Geochronology And Thermochronology By The 40Ar/39Ar Method

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Argon isotopic dating is one of the most important techniques for estimating the ages of rocks and can be used on very small samples. It has been used to assign reliable ages to the Earth and numerous earth sciences. This second edition covers the standard principles and methods and incorporates many of new developments from the last decade. It covers the basis of the method, technical aspects, data presentation, diffusion theory, thermochronology, and many applications and case studies.

Petrochronology Mar 27 2021
Petrochronology is a rapidly emerging branch of Earth science that links time (ages or rates) with specific rock-forming processes and their environment. It is founded in petrology and geochemistry, which define a petrogenetic context or limit a specific process, to which chronometric data are then linked. This combination informs Earth’s petrogenetic processes better than petrology or geochronology alone. This volume and the accompanying short courses address three broad categories of inquiry. Conceptual approaches chapters include petrologic modeling of multi-component chemical and mineralogic systems, and development of methods that include diffusive alteration of mineral chemistry. Methods chapters address four main analytical techniques, specifically EPMA, LA-ICP-MS, SIMS and TIMS. Mineral-specific chapters explore applications to a wide range of minerals, including zircon (metamorphic, igneous, and detrital/Hadean), baddeleyite, REE minerals (monazite, allanite, xenotime and apatite), titanite, rutile, garnet, and major igneous minerals (olivine, plagioclase and pyroxenes). These applications mainly focus on metamorphic, igneous, or tectonic processes, but additionally elucidate fundamental transitional processes in crystal growth, and how chemical transport and deformation affect chemically complex mineral composites. Most chapters further recommend areas of future research.

40Ar/39Ar Chronology of Chronologic Events in the AND-1B Drillcore
Feb 12 2020
40Ar/39Ar dating of a suite of volcanic clasts and tephras, collected from throughout the AND-1B drillcore, significantly aids the development of an age-depth model. High precision dates determined for a variety of volcanic materials, provide the necessary pinning points useful in constraining the geochronology of the drillcore. The ages for five stratigraphic intervals are 1) 85.53-85.85 mbsf felsic tephra (1.014±0.004 Ma), 2) ~112-145 mbsf sequence of basaltic tephra (1.65±0.05 to 1.67±0.05 Ma), 3) 481.80 mbsf pumice-rich mudstone (480.00±0.076 Ma), 4) 646.30-649.34 mbsf basaltic lava flow (6.48±0.13 Ma), and 5) ~1280 mbsf, three volcanic clasts (maximum depositional age 13.57±0.13 Ma). Dating of volcanic clasts from the interval below ~650 mbsf, provide the best means for constraining the depositional ages for this interval. Electron microprobe characterization of numerous volcanic intervals indicates that preservation of volcanic tephra is highly dependent on depositional depth. Tephras from 0 to ~650 mbsf, are generally fresh and well preserved, whereas material from greater than ~650 mbsf exhibits high degrees of alteration. Volcanic clasts, unlike tephras below 600 mbsf, display only minor alteration, and many are good candidates for 40Ar/39Ar analysis. Both groundmass concentrates and feldspar mineral separates from volcanic clasts have yielded high precision dates. We are currently working on a suite of 100 volcanic clasts in an attempt to provide maximum depositional ages for the ~650-1280 mbsf interval.

Depositional Conditions and 40Ar/39Ar Dating of Fault Activity Registered by Phyllosilicates (clay Minerals) in a Sedimentary Environment Jul 31 2021
The Pyrenees belt features well-exposed deformation structures and well preserved syntectonic sedimentary rocks that make it ideally suited to study thrust processes. The texture, structure and chemical-isogetic compositions of synkinematicphyllosilicates are widely used to identify the deformation mechanisms and controlling factors of fault activities. Therefore, in the present thesis, these phyllosilicates from the Pyrenean orogen have been studied to better understand the mechanical, chemical and isotopic behavior of phyllosilicates from deformed sediments of Eocene-Trassic age that have been involved in large southverging shear zones. This work combined petrographic observation, chemical analyses, and thermodynamic modeling with 40Ar/39Ar geochronology on muscovite/ilite and chlorite. The first studied fault is the Pic de Port Vieux thrust (PPVT), a second-order thrust related to the major Gavarnie thrust (GT) in the south-western part of the Pyrenees Axial Zone. The dissolutionrecrystallization,pressure solution, and interaction with highly reductive fluids are the main parameters responsible for the mineralogical and chemical changes in the fault core zone. The Kübler index and chlorite thermometry suggest upperamphibolite epizonal conditions with a temperature of 285°C a 28°C for the PPVT activity. Moreover, the 40Ar/39Ar step-heating dating of synkinematic muscovite indicates that the fault activity occurred at 36.9 ± 0.2 Ma which coincides with the activity of the GT. The two other faults are: Lakora thrust that is located on the southern edge of the North Pyrenean Zone, and the MontePerdido thrust (Torla location) situated on the western part of the South Pyrenean Zone. The two thrusts are affected (deformed) by the emplacement of the Gavarnie fault. The petrographic-microstructural analyses on these faults indicate that deformation is marked by folding, boudinage, intense cleavage, shear surfaces/veins and enrichment of phyllosilicates in the fault zone of both thrusts. Similar to the PPVT, pressure-solution and dissolution-recrystallization mechanisms are the main mechanisms that control deformation and enhanced the enrichment of the newly-formed phyllosilicates in the fault zones of both faults. Based on the Kübler index measurements, the deformation in the Lakora and Torla faults occurred at relativelylower temperature compared to the PPVT. The youngest total gas ages obtained by the 40Ar/39Ar technique are very old for that activity time of both thrusts as they are older than the depositional ages of the sediments in the fault zones. Further investigations are proposed at the end of this dissertation in order to better understand this anomaly in age and to successfully obtain the rightage of the two thrusts activities. Based on the results of this thesis, phyllosilicate minerals proved to be reliable thermochronological tools for fault activity studies, which can be combined with careful sample preparations and detailed sample characterization.

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