

Supplementary Figures

$^{40}\text{Ar}/^{39}\text{Ar}$ Geochronology of Magmatic-Steam Alunite from Alunite Ridge and Deer Trail Mountain, Marysville Volcanic Field, Utah: Timing and Duration of Miocene Hydrothermal Activity Associated with Concealed Intrusions

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Supplemental Figures

Release Spectra – Alunite

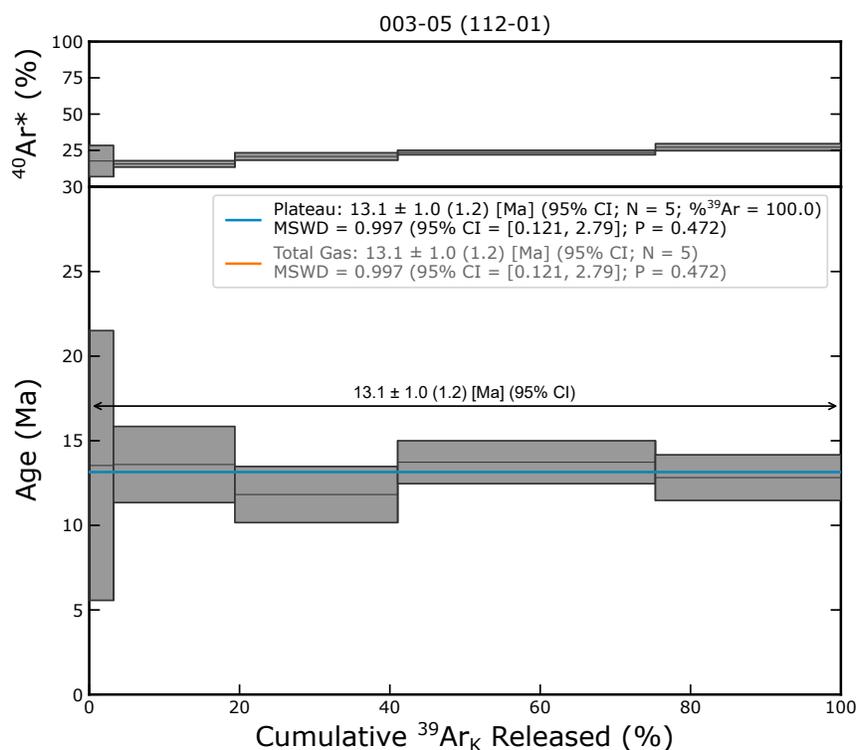


Figure S1. $^{40}\text{Ar}/^{39}\text{Ar}$ release spectrum for sample 003-05 (112-01), from the Mt. Edna prospect. External age uncertainties are in parentheses.

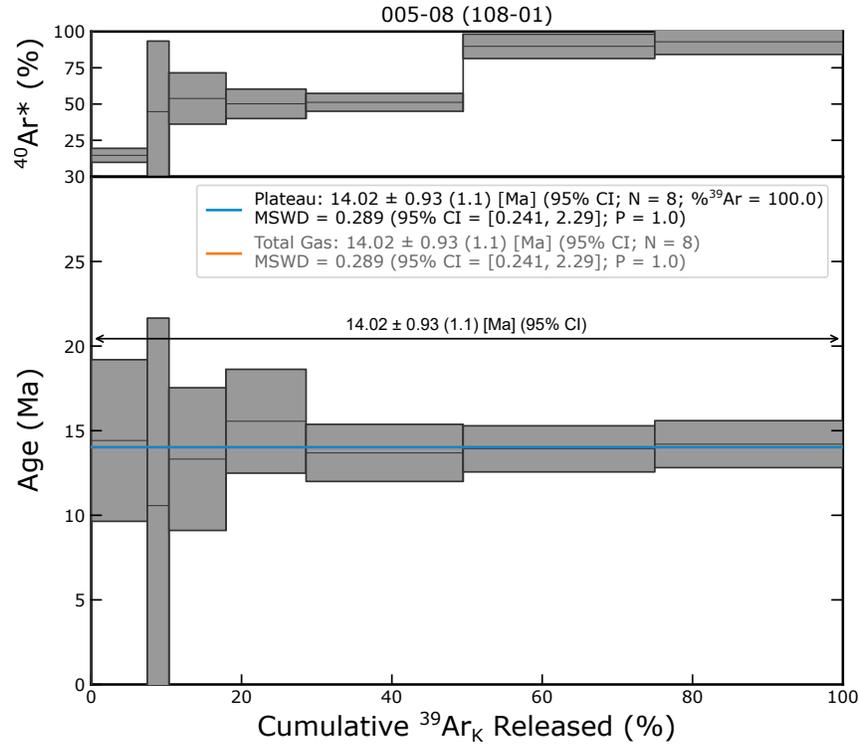


Figure S2. $^{40}\text{Ar}/^{39}\text{Ar}$ release spectrum for sample 005-08 (108-01), from the L&N mine. External age uncertainties are in parentheses.

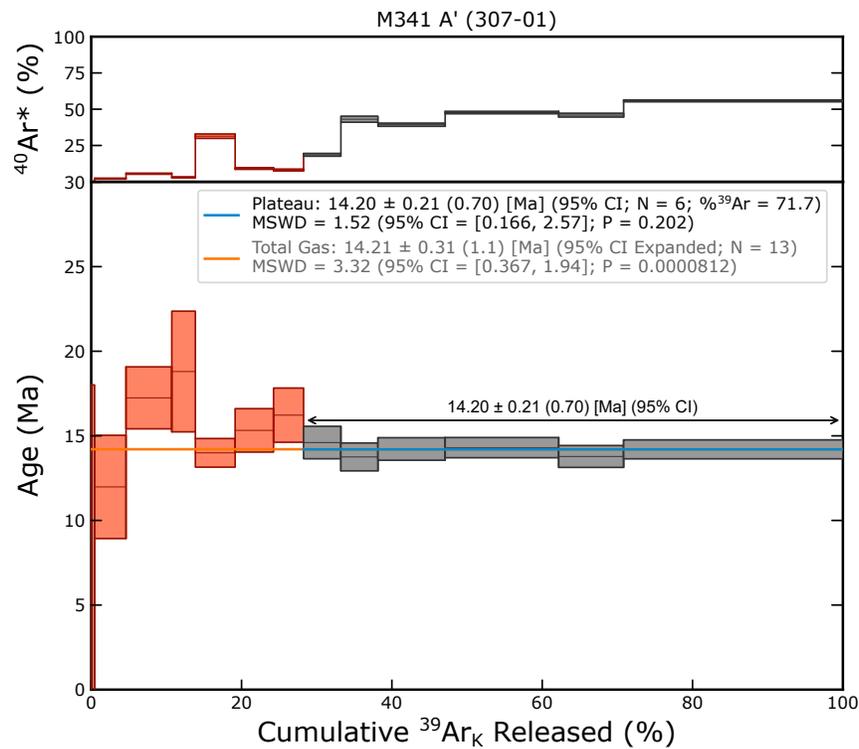


Figure S3. $^{40}\text{Ar}/^{39}\text{Ar}$ release spectrum for sample M341 A' (307-01), from the Christmas mine. Dates in red have been excluded from the plateau. External age uncertainties are in parentheses.

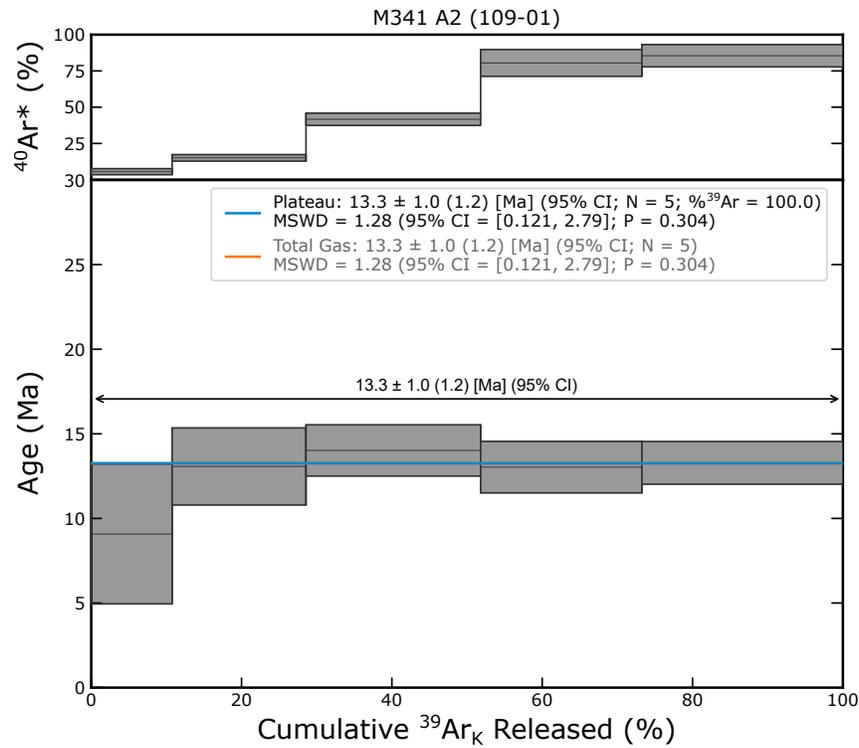


Figure S4. $^{40}\text{Ar}/^{39}\text{Ar}$ release spectrum for sample M341 A2 (109-01), from the Christmas mine. External age uncertainties are in parentheses.

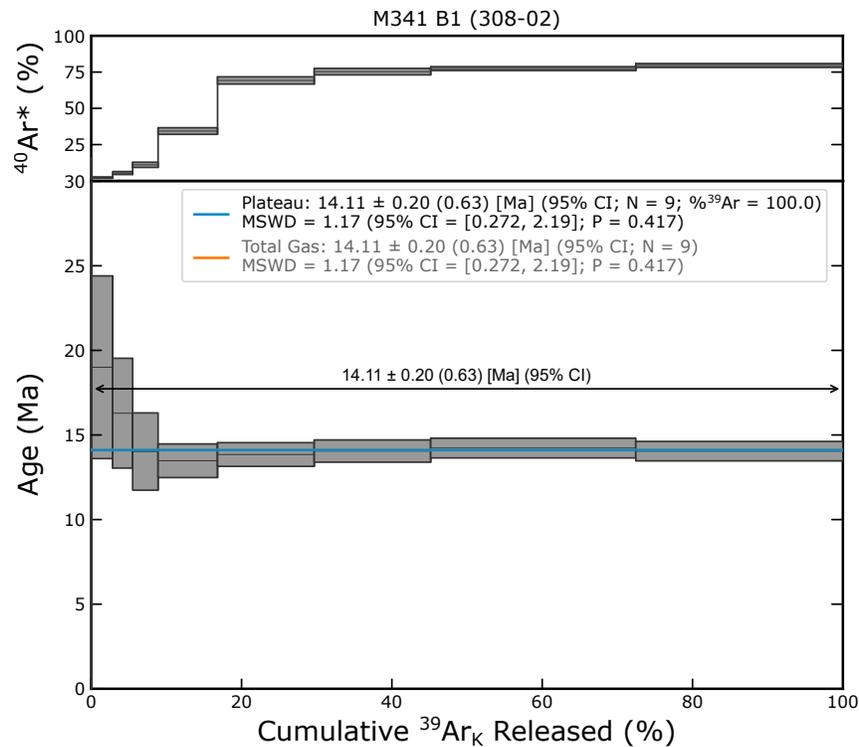


Figure S5. $^{40}\text{Ar}/^{39}\text{Ar}$ release spectrum for sample M341 B1 (308-02), from the Christmas mine. External age uncertainties are in parentheses.

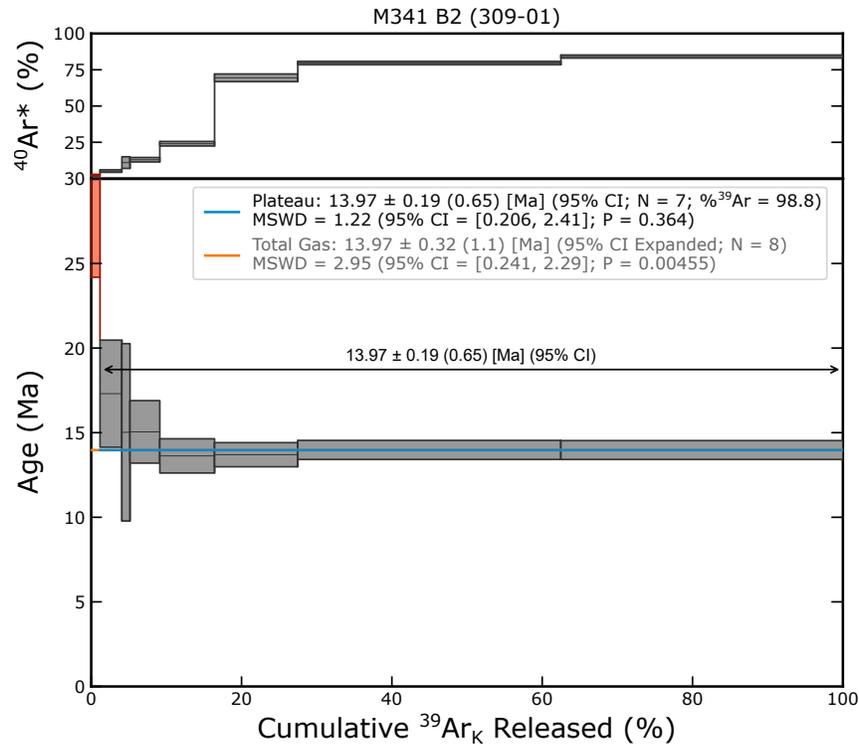


Figure S6. $^{40}\text{Ar}/^{39}\text{Ar}$ release spectrum for sample M341 B2 (309-01), from the Christmas mine. Dates in red have been excluded from the plateau. External age uncertainties are in parentheses.

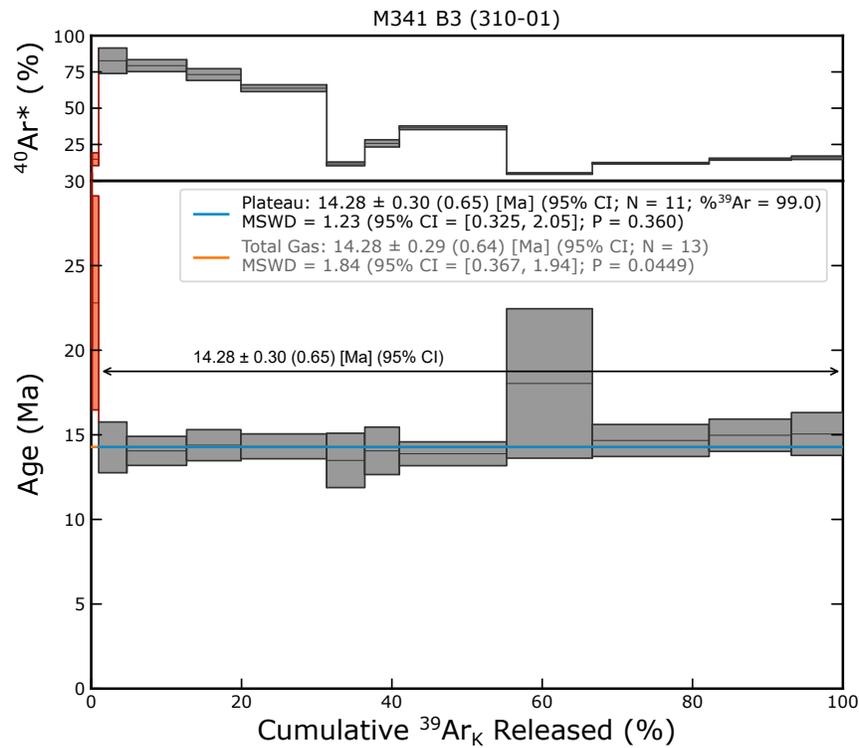


Figure S7. $^{40}\text{Ar}/^{39}\text{Ar}$ release spectrum for sample M341 B3 (310-01), from the Christmas mine. Dates in red have been excluded from the plateau. External age uncertainties are in parentheses.

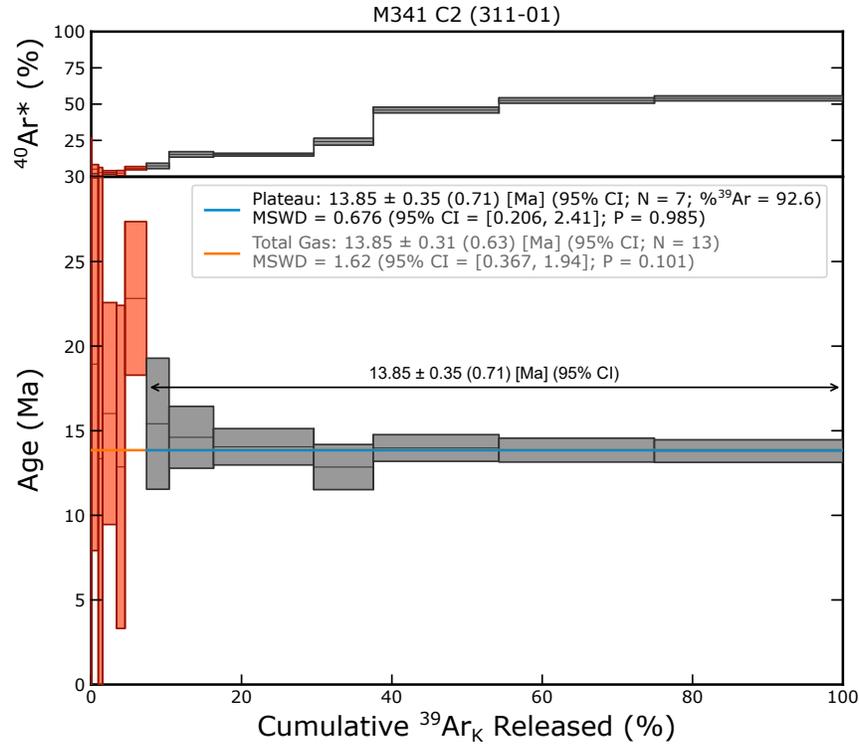


Figure S8. $^{40}\text{Ar}/^{39}\text{Ar}$ release spectrum for sample M341 C2 (311-01), from the Christmas mine. Dates in red have been excluded from the plateau. External age uncertainties are in parentheses.

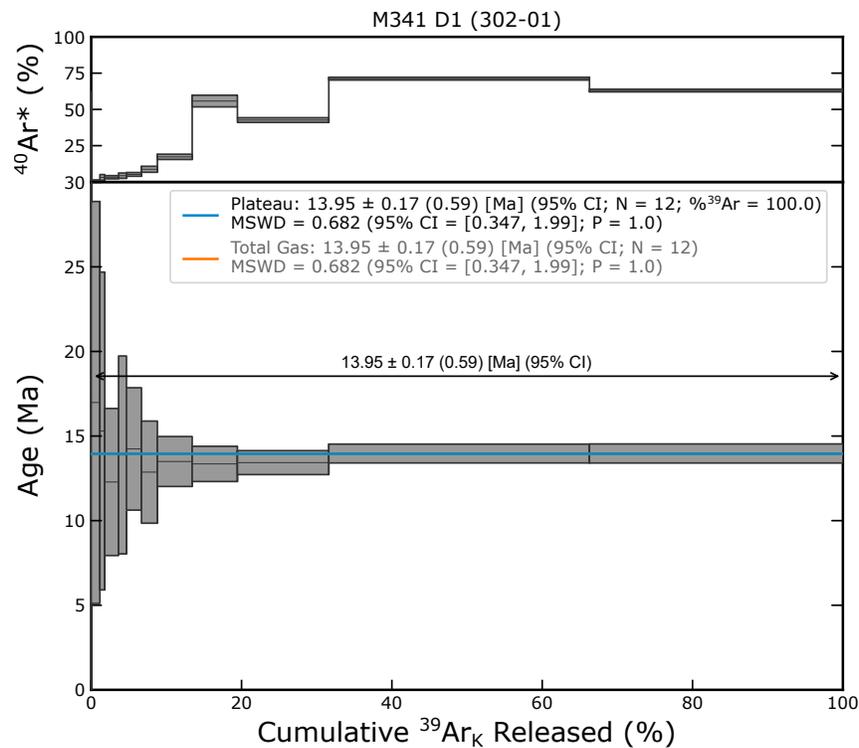


Figure S9. $^{40}\text{Ar}/^{39}\text{Ar}$ release spectrum for sample M341 D1 (302-01), from the Christmas mine. External age uncertainties are in parentheses.

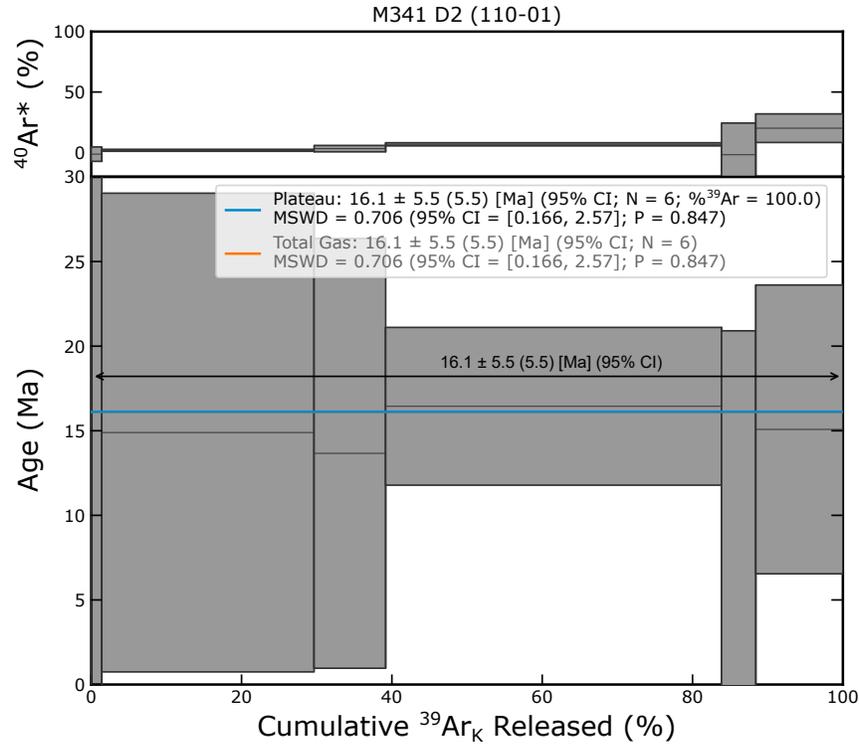


Figure S10. $^{40}\text{Ar}/^{39}\text{Ar}$ release spectrum for sample M341 D2 (110-01), from the Christmas mine. External age uncertainties are in parentheses.

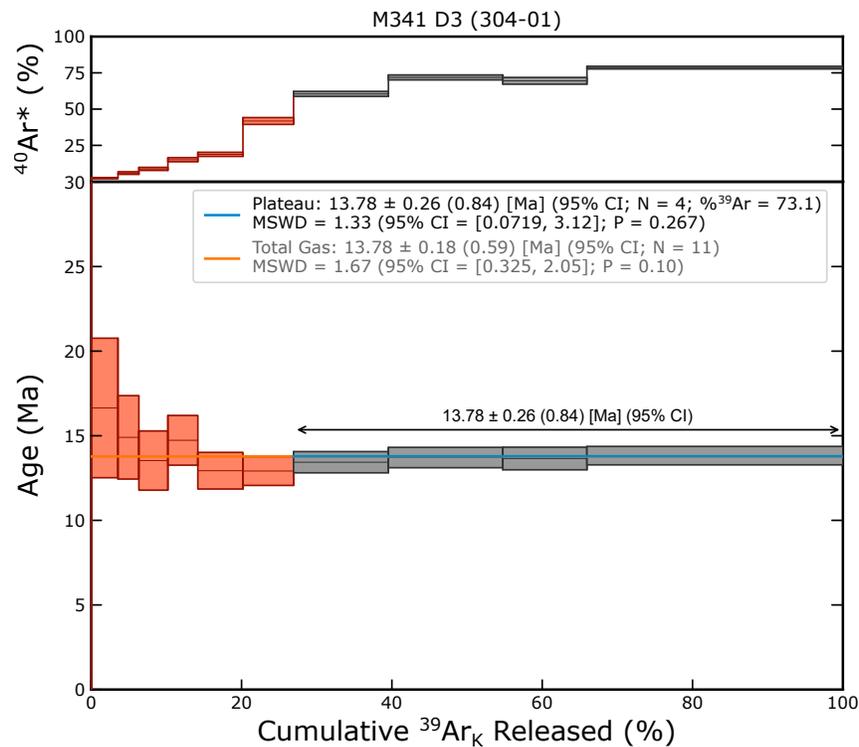


Figure S11. $^{40}\text{Ar}/^{39}\text{Ar}$ release spectrum for sample M341 D3 (304-01), from the Christmas mine. Dates in red have been excluded from the plateau. External age uncertainties are in parentheses.

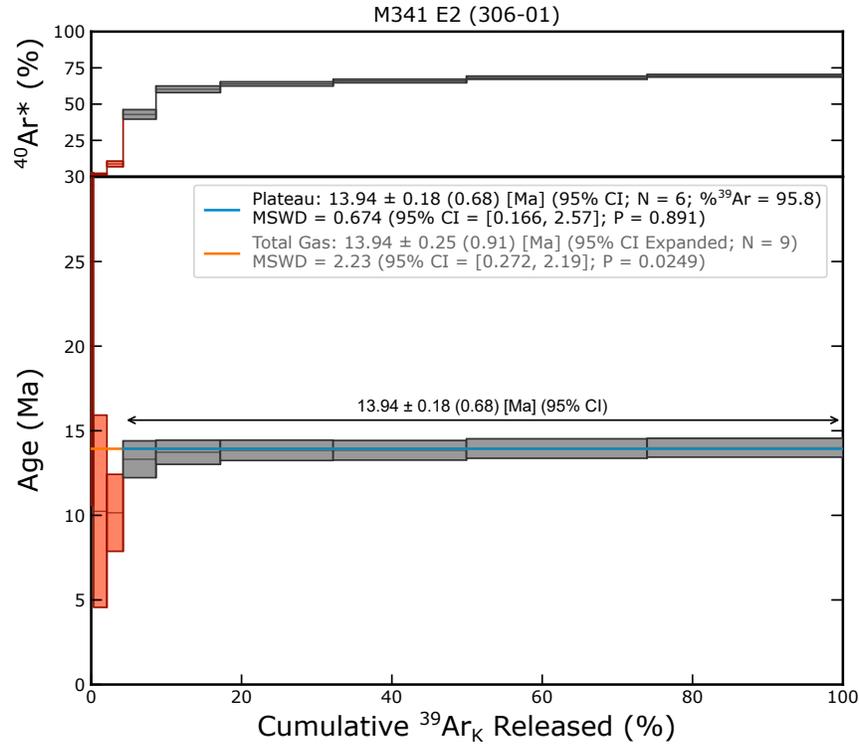


Figure S12. $^{40}\text{Ar}/^{39}\text{Ar}$ release spectrum for sample M341 E2 (306-01), from the Christmas mine. Dates in red have been excluded from the plateau. External age uncertainties are in parentheses.

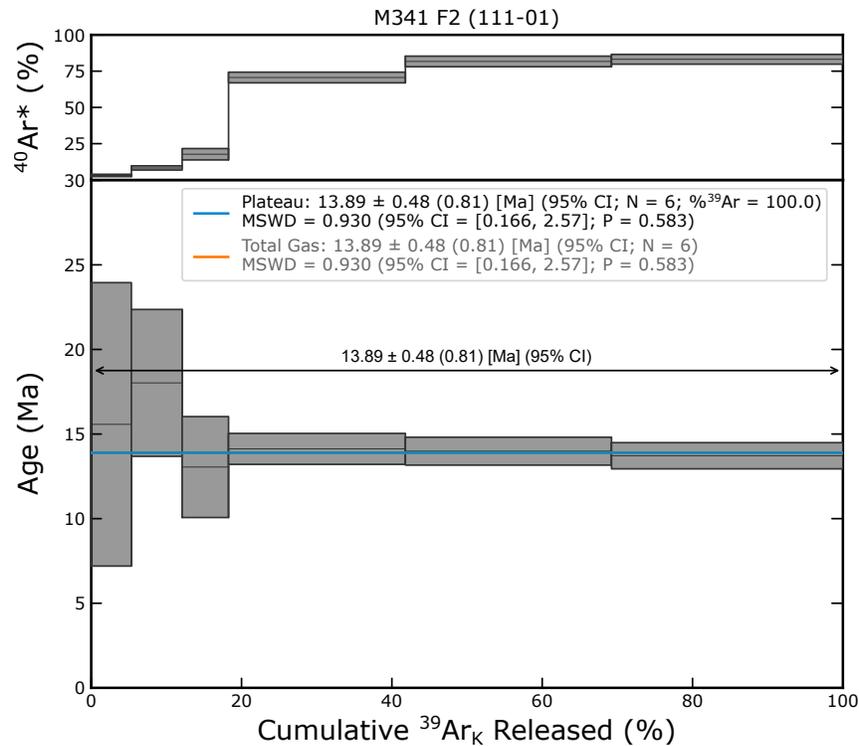


Figure S13. $^{40}\text{Ar}/^{39}\text{Ar}$ release spectrum for sample M341 F2 (111-01), from the Christmas mine. External age uncertainties are in parentheses.

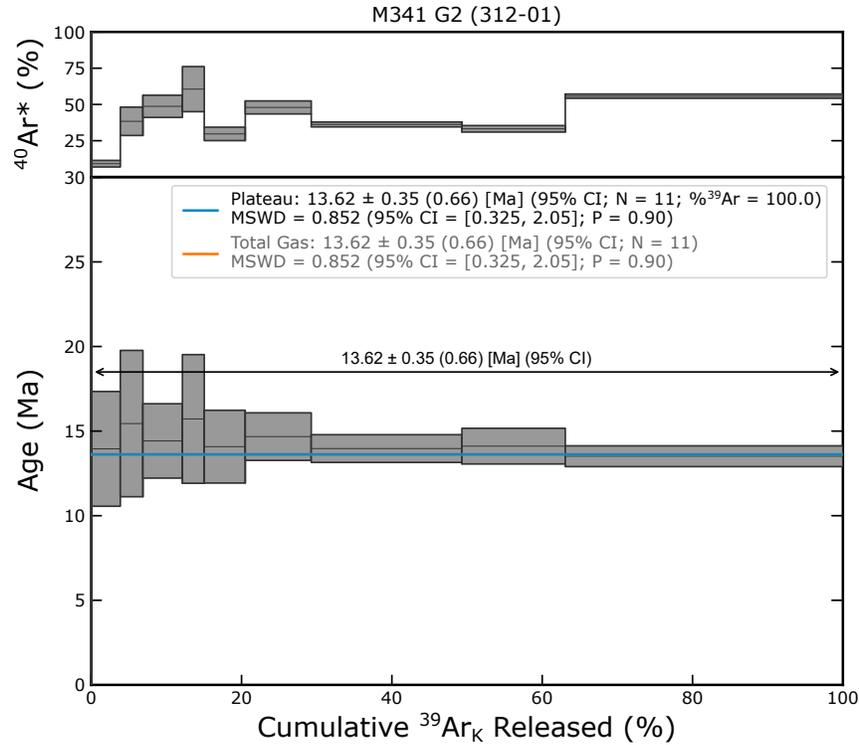


Figure S14. $^{40}\text{Ar}/^{39}\text{Ar}$ release spectrum for sample M341 G2 (312-01), from the Christmas mine. External age uncertainties are in parentheses.

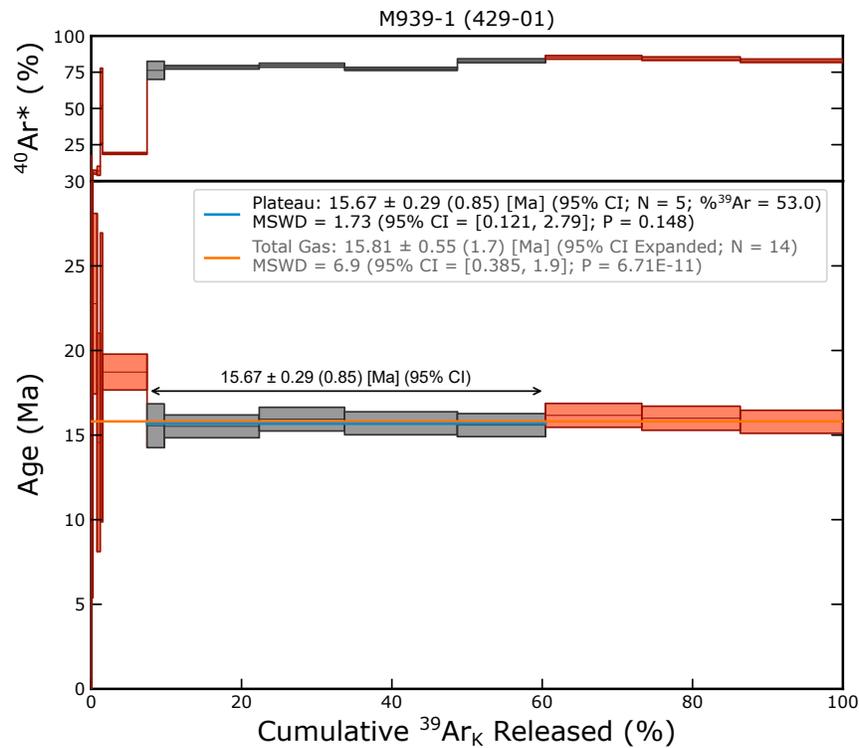


Figure S15. $^{40}\text{Ar}/^{39}\text{Ar}$ release spectrum for sample M939-1 (429-01), from the upper Mineral Products mine. Dates in red have been excluded from the plateau. External age uncertainties are in parentheses.

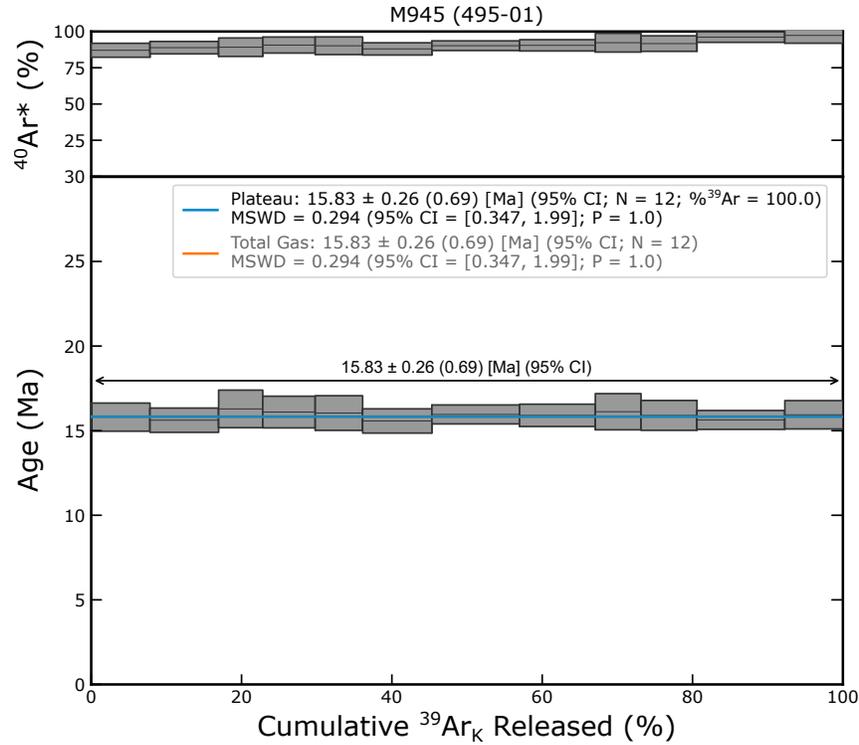


Figure S16. $^{40}\text{Ar}/^{39}\text{Ar}$ release spectrum for sample M945 (495-01), from the upper Mineral Products mine. External age uncertainties are in parentheses.

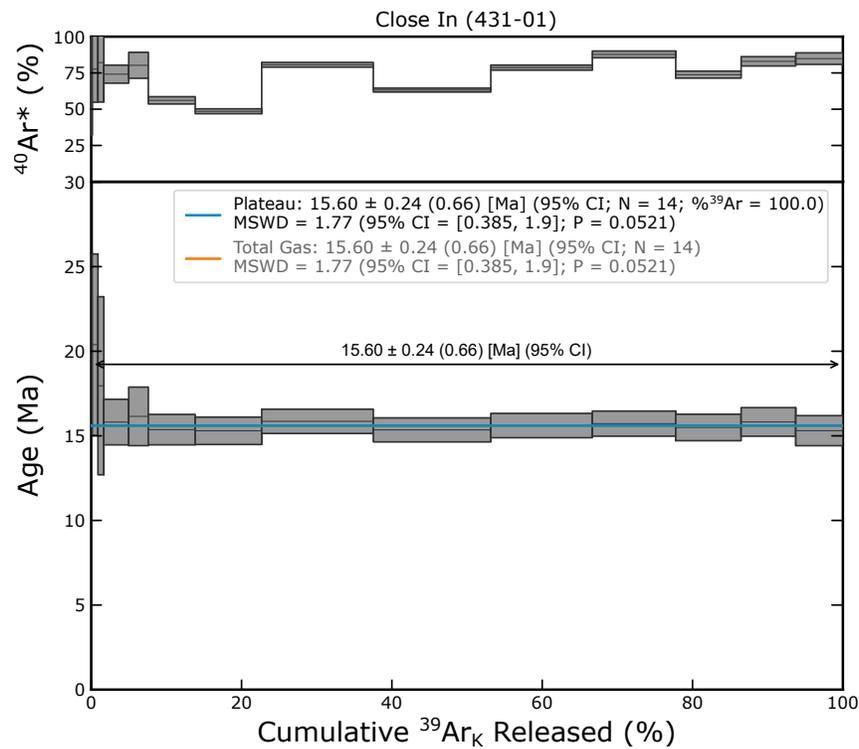


Figure S17. $^{40}\text{Ar}/^{39}\text{Ar}$ release spectrum for sample Close In (431-01), from the mine dump at the edge of the Sevier Valley. External age uncertainties are in parentheses.

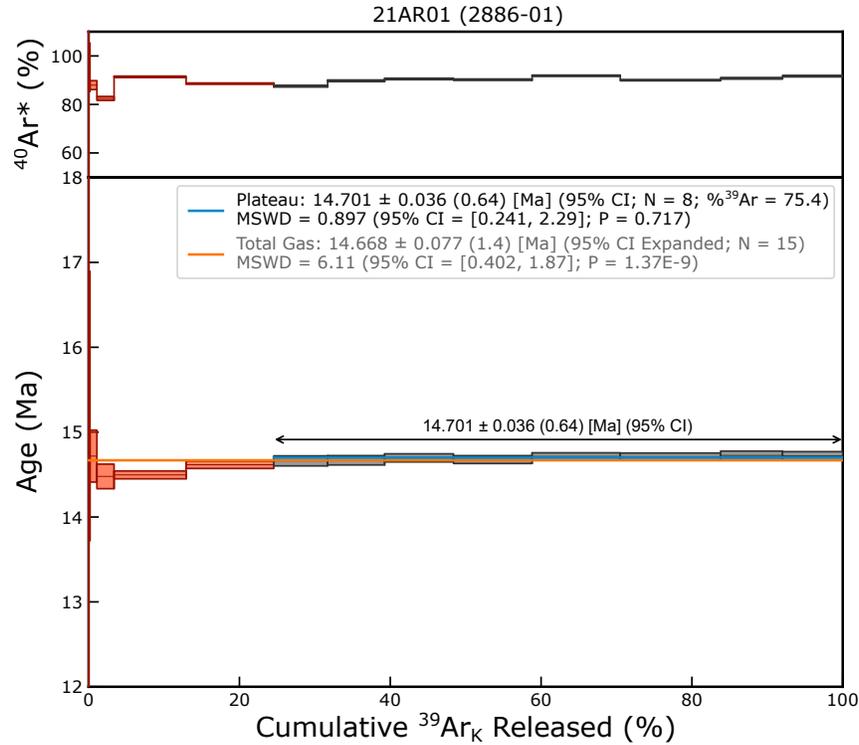


Figure S18. $^{40}\text{Ar}/^{39}\text{Ar}$ release spectrum for sample 21AR01 (2886-01), from the L&N mine. Dates in red have been excluded from the plateau. External age uncertainties are in parentheses.

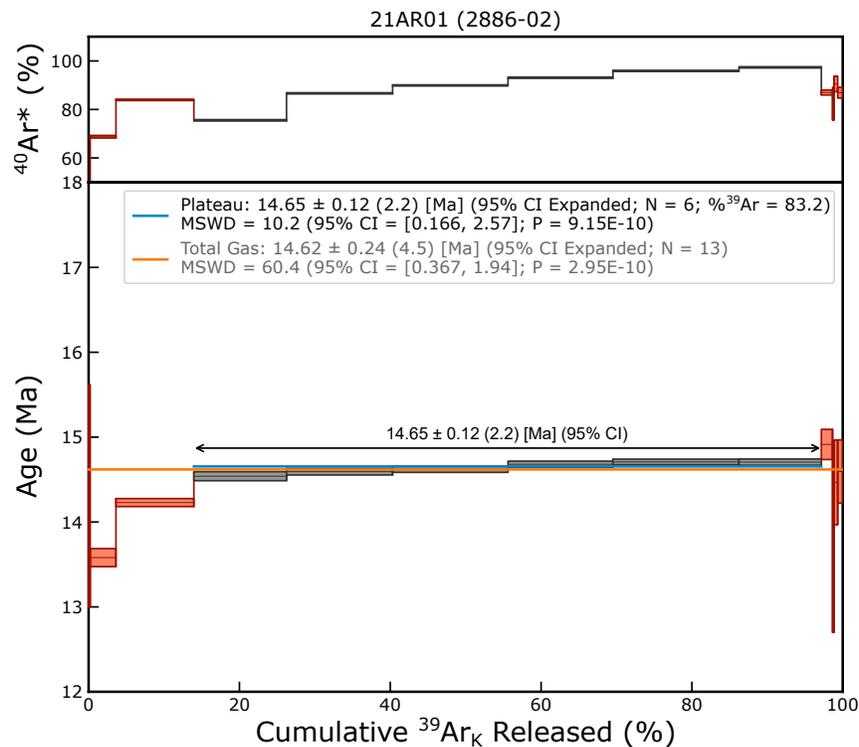


Figure S19. $^{40}\text{Ar}/^{39}\text{Ar}$ release spectrum for sample 21AR01 (2886-02), from the L&N mine. Dates in red have been excluded from the plateau. External age uncertainties are in parentheses.

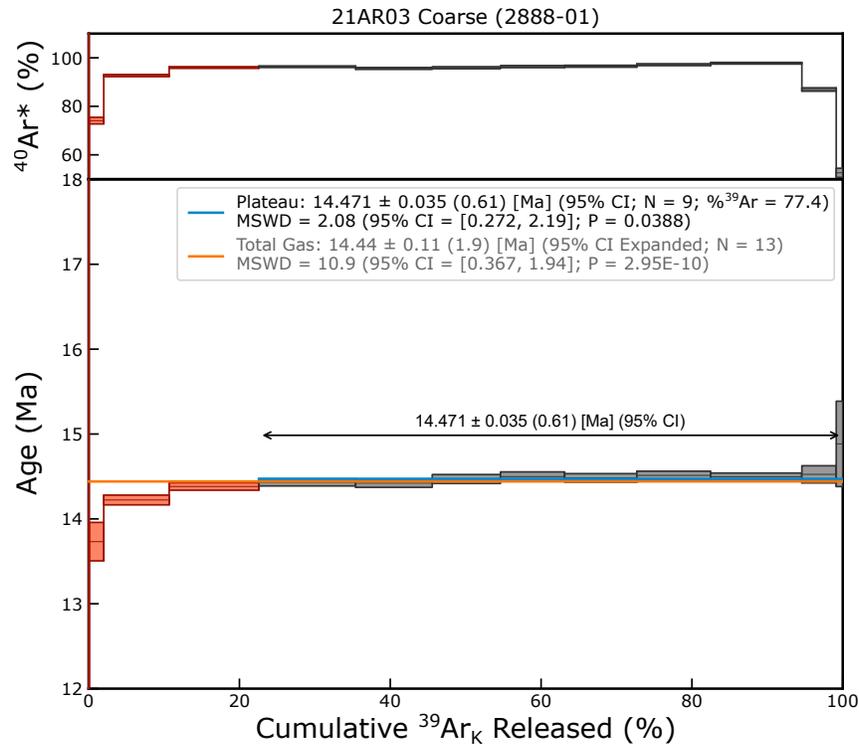


Figure S20. $^{40}\text{Ar}/^{39}\text{Ar}$ release spectrum for sample 21AR03 Coarse (2888-01), from the Christmas mine. Dates in red have been excluded from the plateau. External age uncertainties are in parentheses.

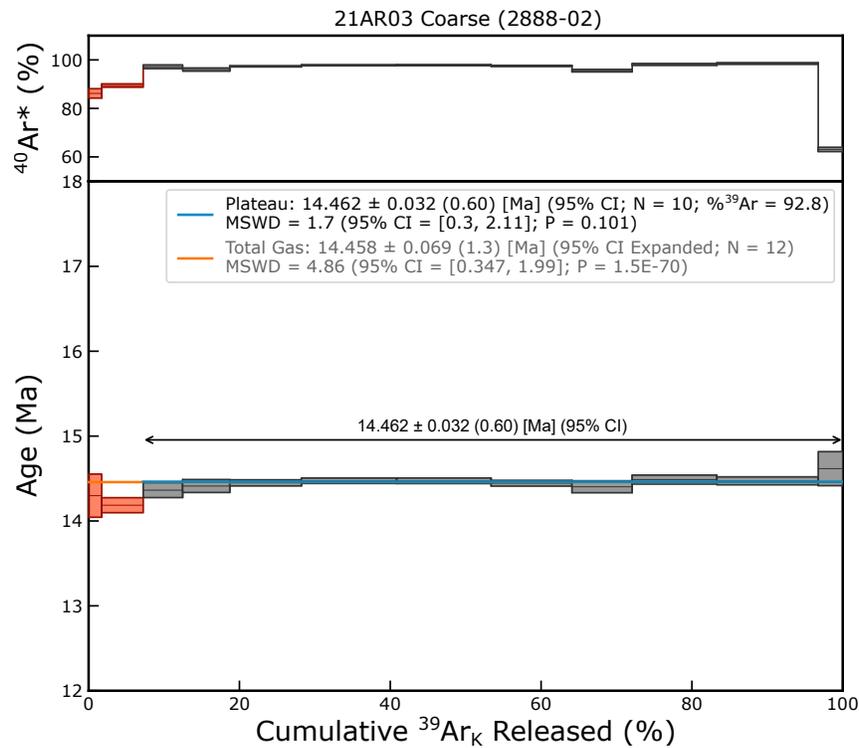


Figure S21. $^{40}\text{Ar}/^{39}\text{Ar}$ release spectrum for sample 21AR03 Coarse (2888-02), from the Christmas mine. Dates in red have been excluded from the plateau. External age uncertainties are in parentheses.

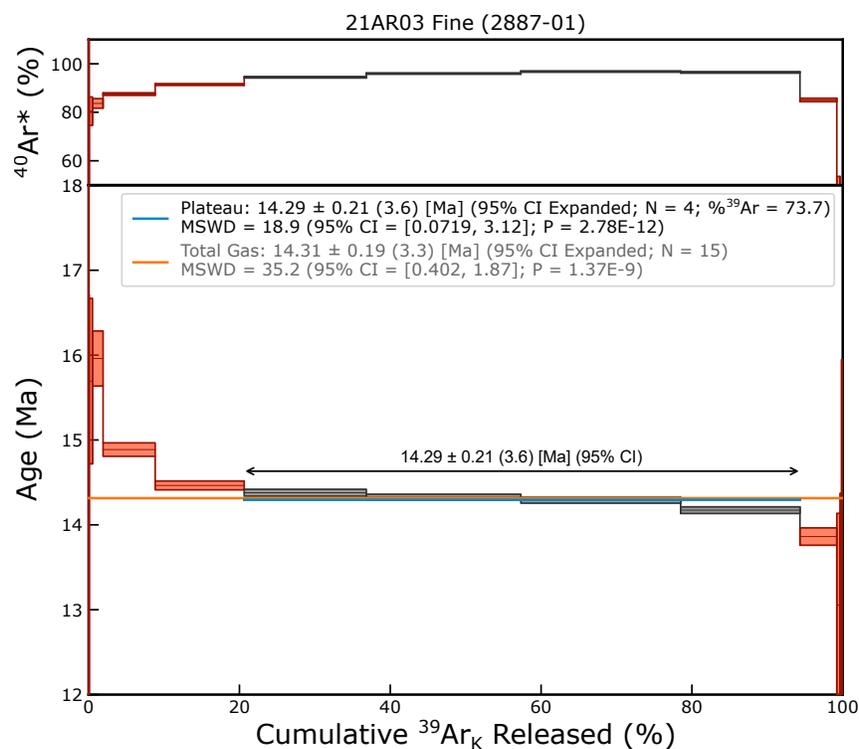


Figure S22. $^{40}\text{Ar}/^{39}\text{Ar}$ release spectrum for sample 21AR03 Fine (2887-01), from the Christmas mine. Dates in red have been excluded from the plateau. External age uncertainties are in parentheses.

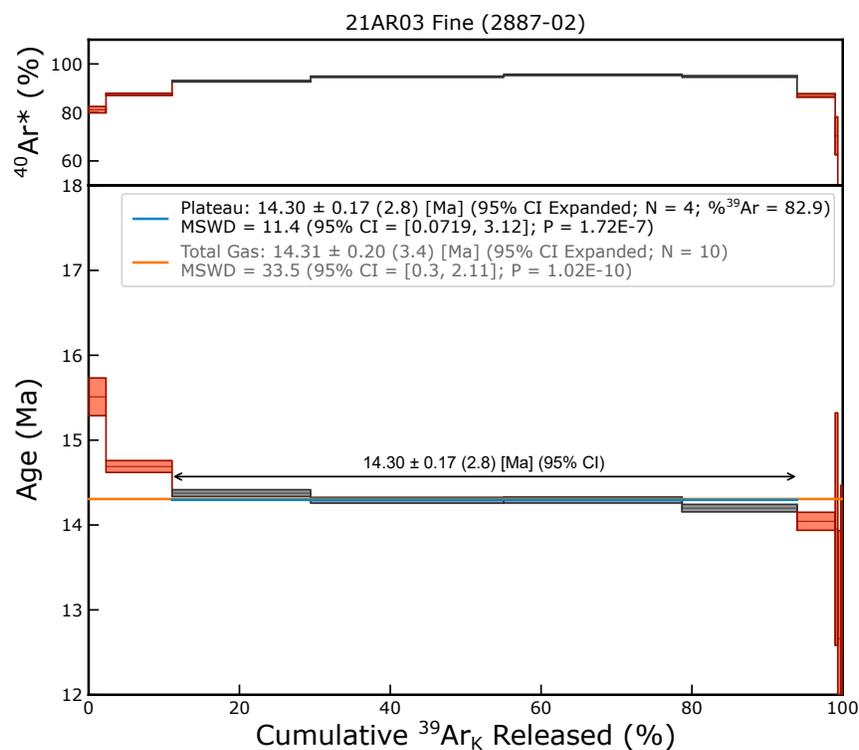


Figure S23. $^{40}\text{Ar}/^{39}\text{Ar}$ release spectrum for sample 21AR03 Fine (2887-02), from the Christmas mine. Dates in red have been excluded from the plateau. External age uncertainties are in parentheses.

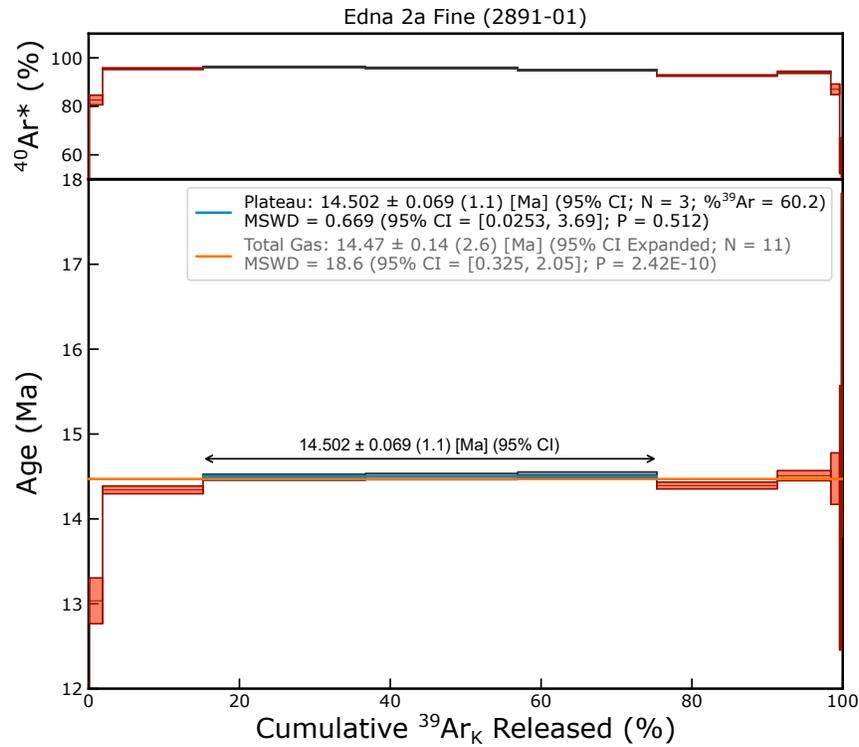


Figure S24. $^{40}\text{Ar}/^{39}\text{Ar}$ release spectrum for sample Edna 2a Fine (2891-01), from the Mt. Edna prospect. Dates in red have been excluded from the plateau. External age uncertainties are in parentheses.

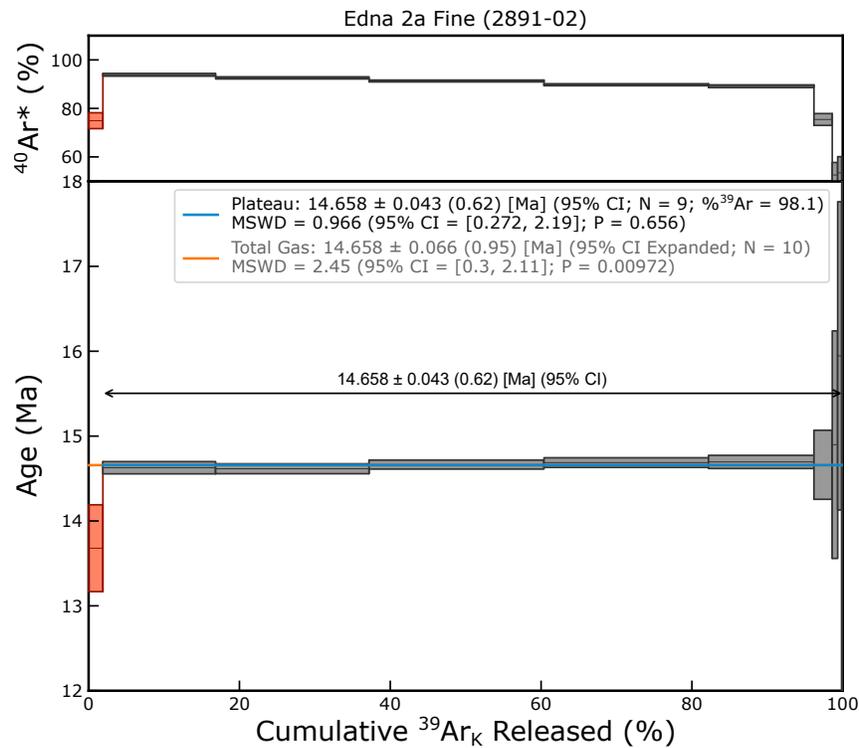


Figure S25. $^{40}\text{Ar}/^{39}\text{Ar}$ release spectrum for sample Edna 2a Fine (2891-02), from the Mt. Edna prosect. Dates in red have been excluded from the plateau. External age uncertainties are in parentheses.

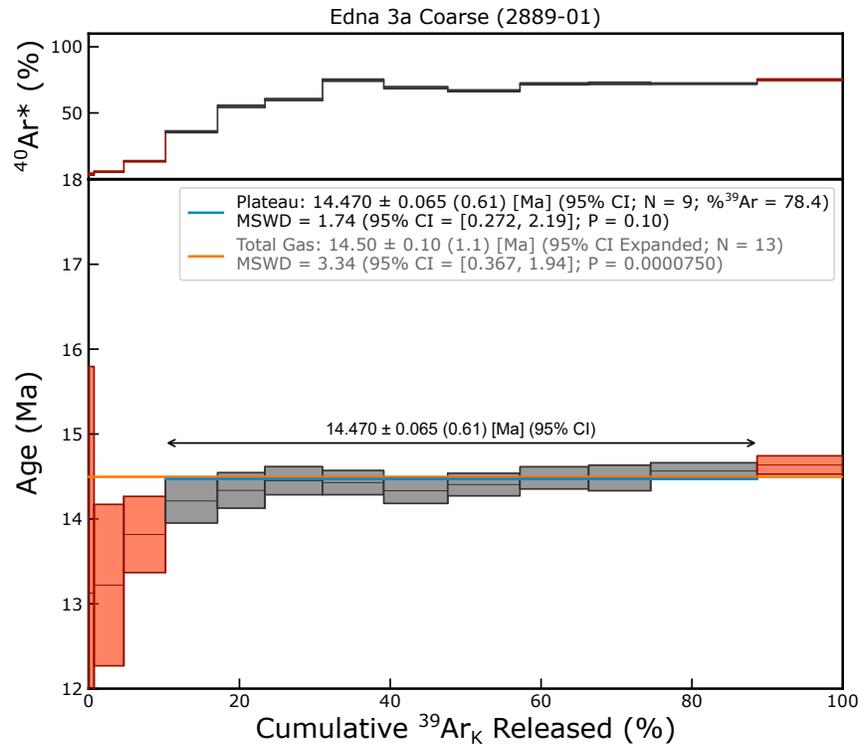


Figure S26. $^{40}\text{Ar}/^{39}\text{Ar}$ release spectrum for sample Edna 3a Coarse (2889-01), from the Mt. Edna prospect. Dates in red have been excluded from the plateau. External age uncertainties are in parentheses.

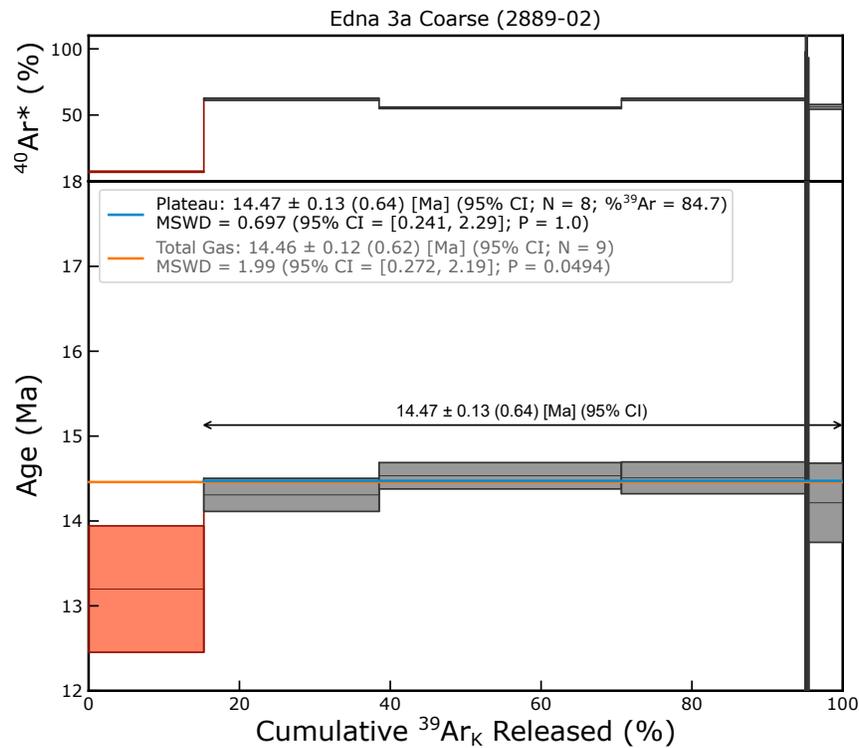


Figure S27. $^{40}\text{Ar}/^{39}\text{Ar}$ release spectrum for sample Edna 3a Coarse (2889-02), from the Mt. Edna prosect. Dates in red have been excluded from the plateau. External age uncertainties are in parentheses.

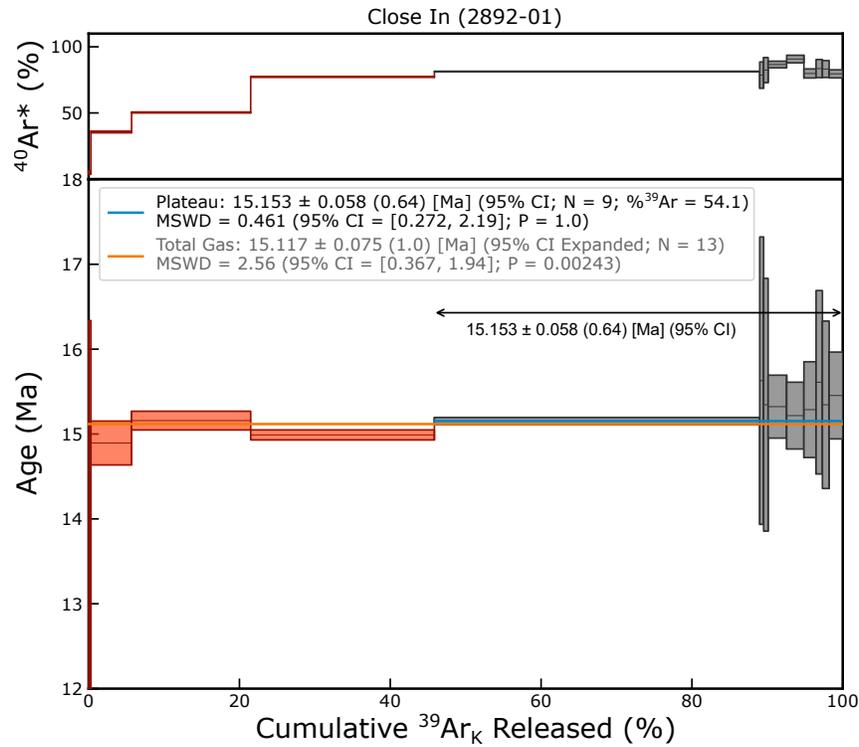


Figure S28. $^{40}\text{Ar}/^{39}\text{Ar}$ release spectrum for sample Close In (2892-01), from the mine dump at the edge of the Sevier Valley. Dates in red have been excluded from the plateau. External age uncertainties are in parentheses.

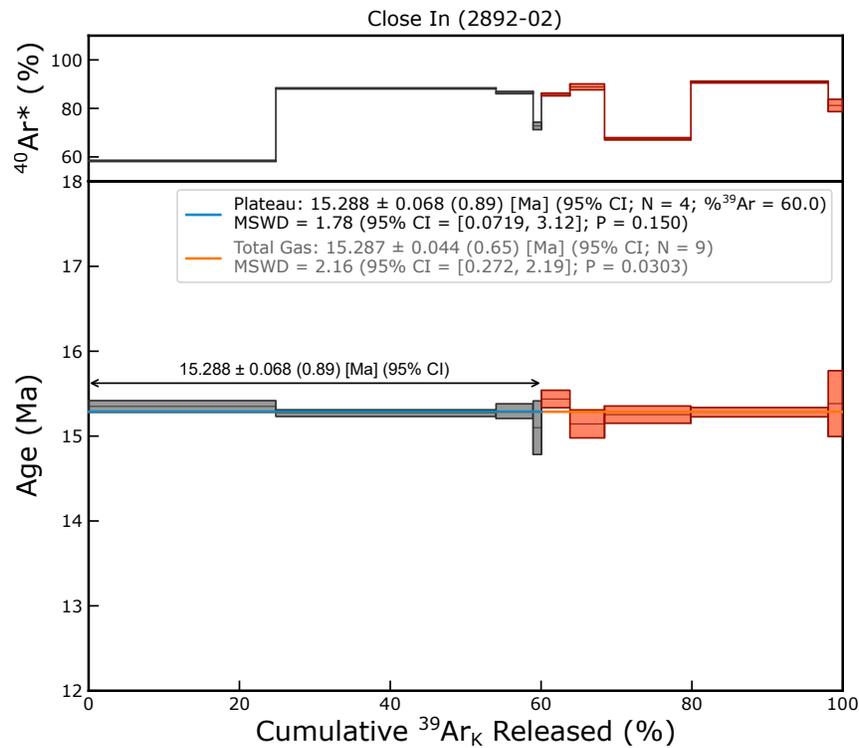


Figure S29. $^{40}\text{Ar}/^{39}\text{Ar}$ release spectrum for sample Close In (2892-02), from the mine dump at the edge of the Sevier Valley. Dates in red have been excluded from the plateau. External age uncertainties are in parentheses.

Release Spectra – Deer Trail Sericite

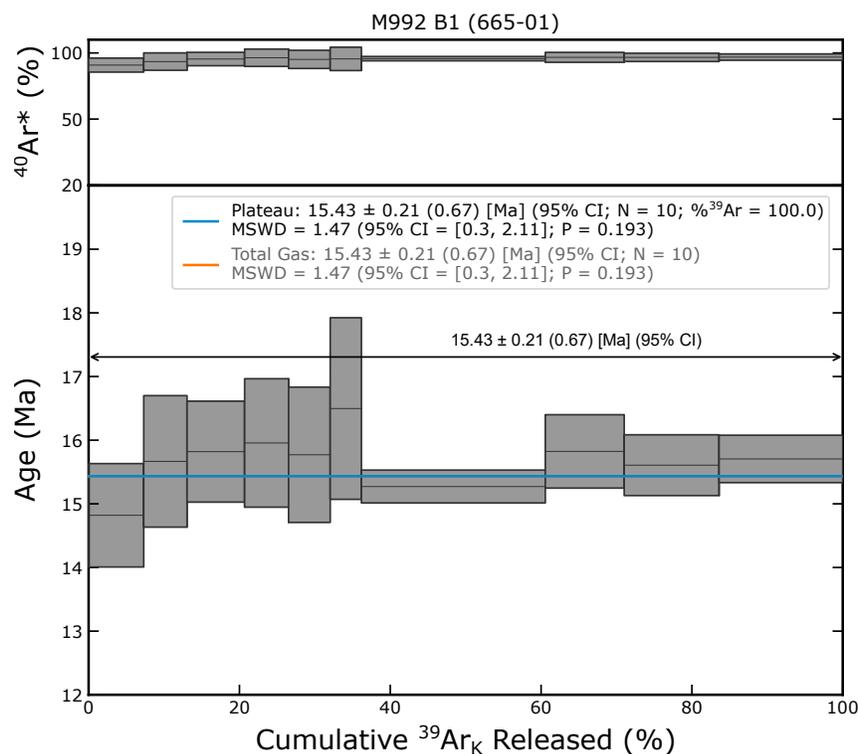


Figure S30. $^{40}\text{Ar}/^{39}\text{Ar}$ release spectrum for sericite from sample M992 B1 (665-01), from the Deer Trail mine workings. External age uncertainties are in parentheses.

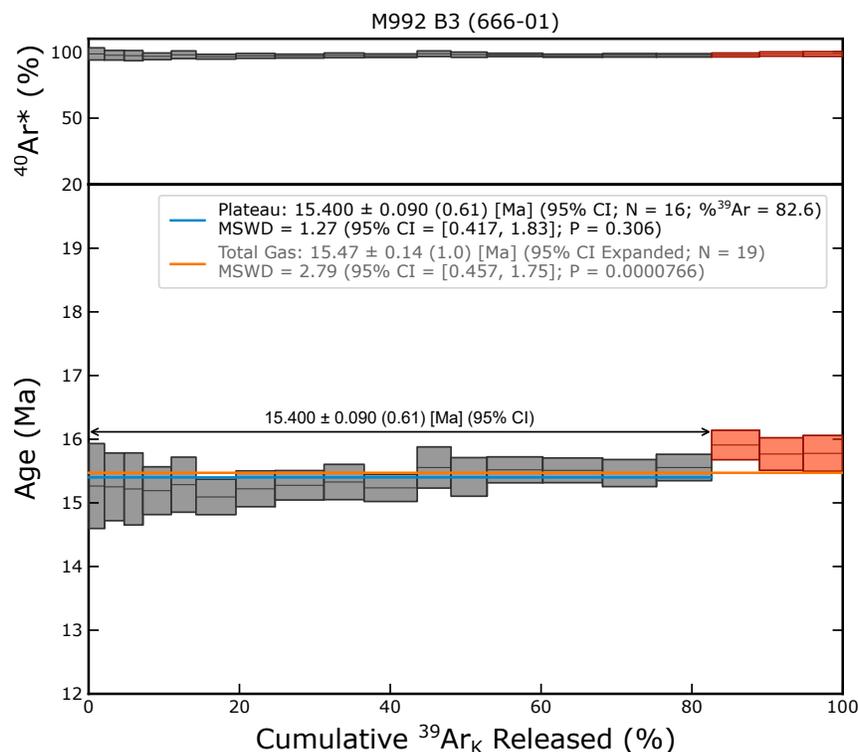


Figure S31. $^{40}\text{Ar}/^{39}\text{Ar}$ release spectrum for sericite from sample M992 B3 (666-01), from the Deer Trail mine workings. Dates in red have been excluded from the plateau. External age uncertainties are in parentheses.

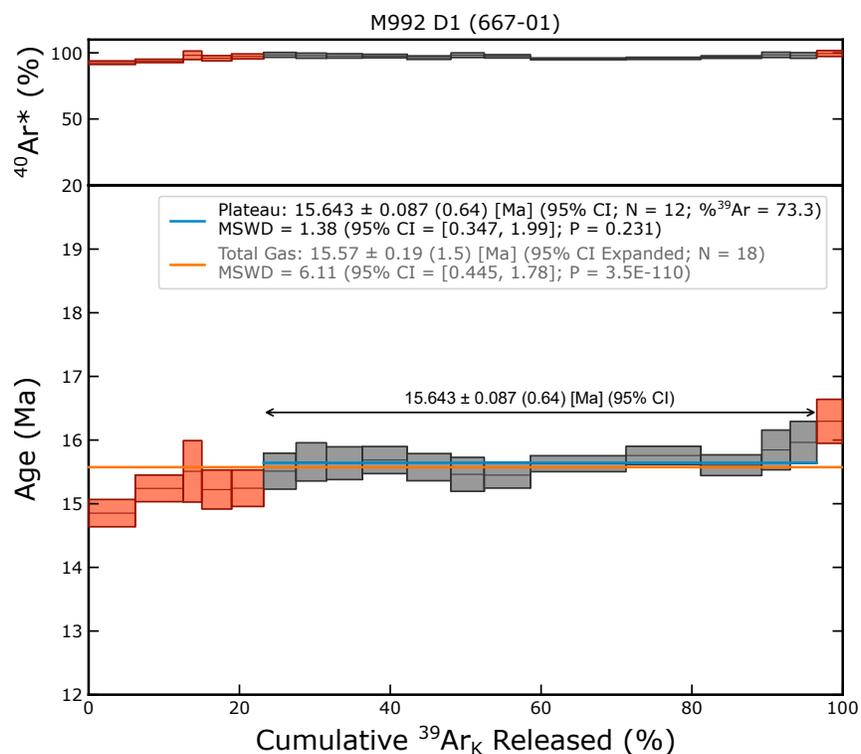


Figure S32. $^{40}\text{Ar}/^{39}\text{Ar}$ release spectrum for sericite from sample M992 D1 (667-01), from the Deer Trail mine workings. Dates in red have been excluded from the plateau. External age uncertainties are in parentheses.

Probability Density Plots

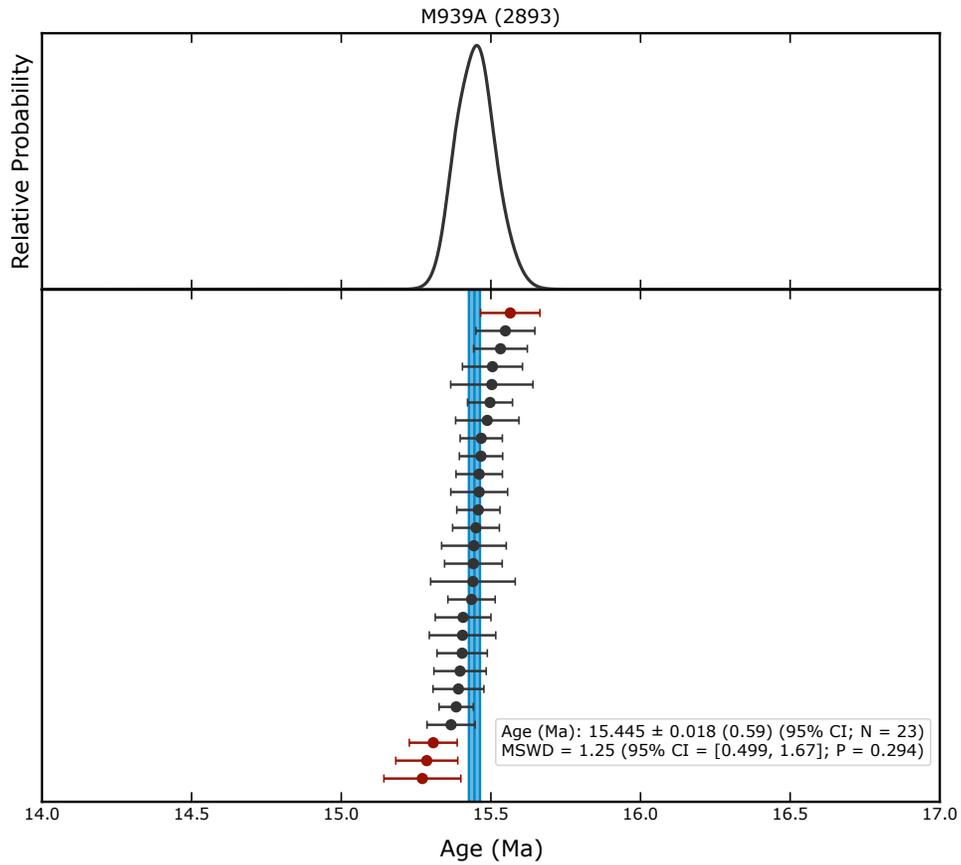


Figure S33. Age sorted $^{40}\text{Ar}/^{39}\text{Ar}$ dates and cumulative probability density for sample M939A (2893), from the upper Mineral Products mine. Dates in red have been excluded from the weighted mean. External age uncertainties are in parentheses.

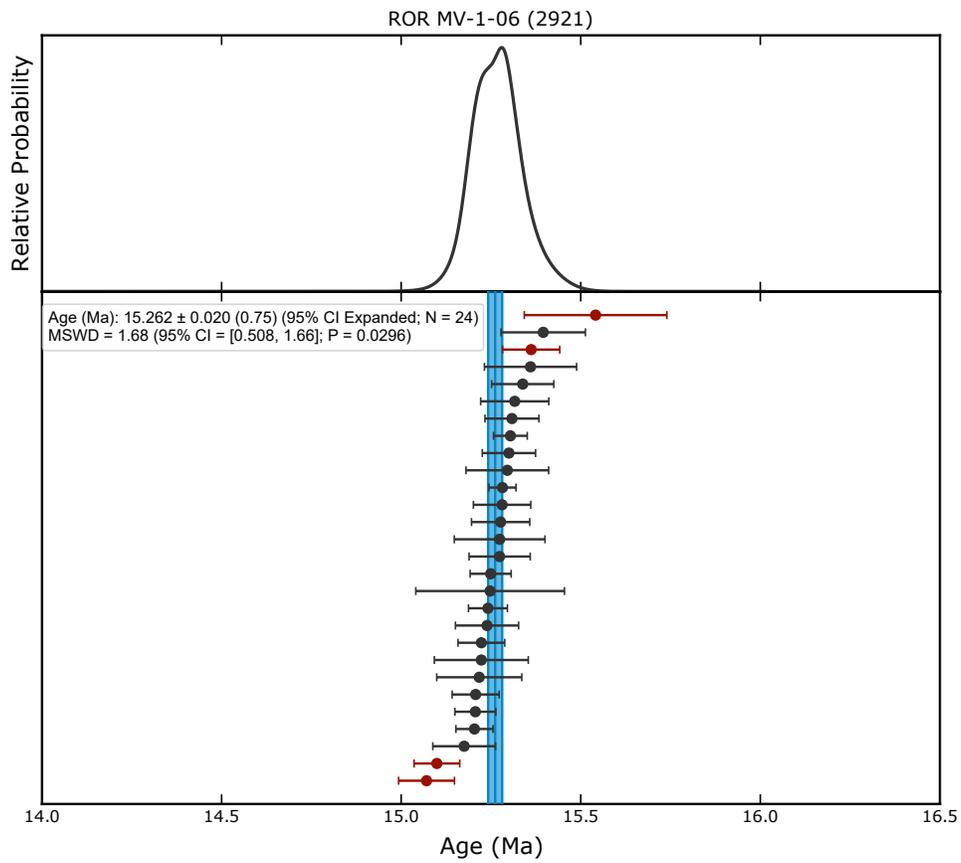


Figure S34. Age sorted $^{40}\text{Ar}/^{39}\text{Ar}$ dates and cumulative probability density for sample ROR MV-1-06 (2921), from the Close In mine dump at the edge of the Sevier Valley. Dates in red have been excluded from the weighted mean. External age uncertainties are in parentheses.

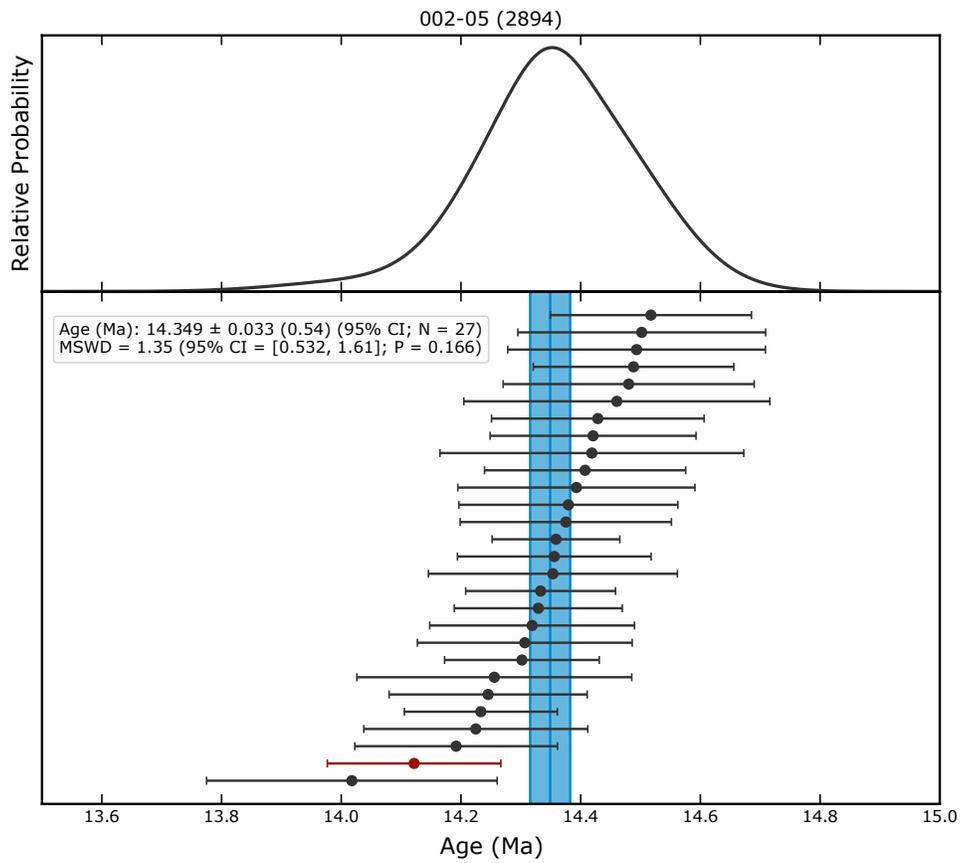


Figure S35. Age sorted $^{40}\text{Ar}/^{39}\text{Ar}$ dates and cumulative probability density for sample 002-05, from the Mt. Edna prospect. Dates in red have been excluded from the weighted mean. External age uncertainties are in parentheses.

Inverse Isochrons

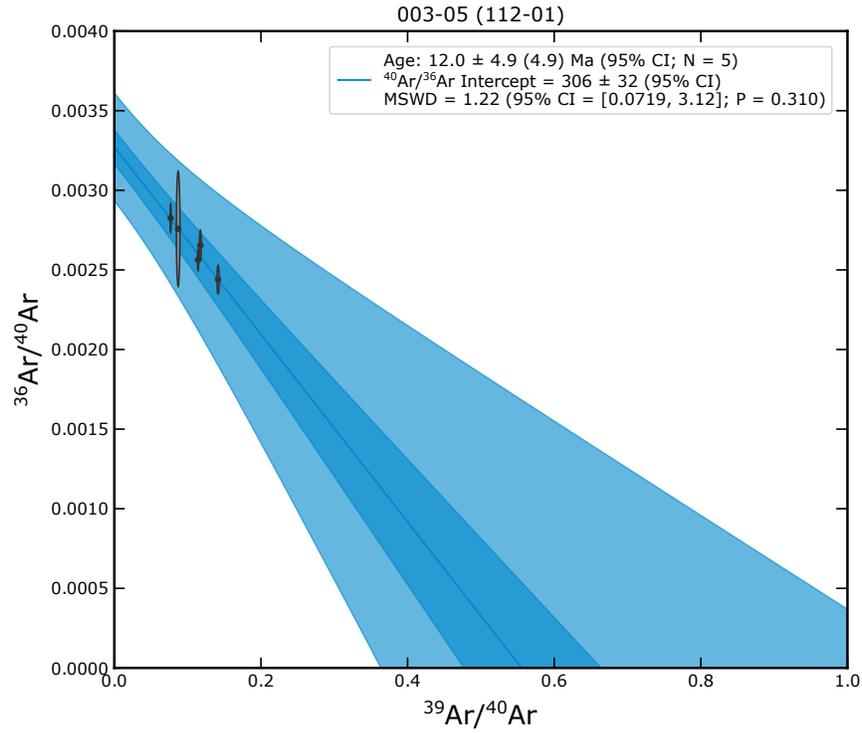


Figure S36. Inverse isochron for sample 003-05 (112-01), from the Mt. Edna prospect. External age uncertainties are in parentheses.

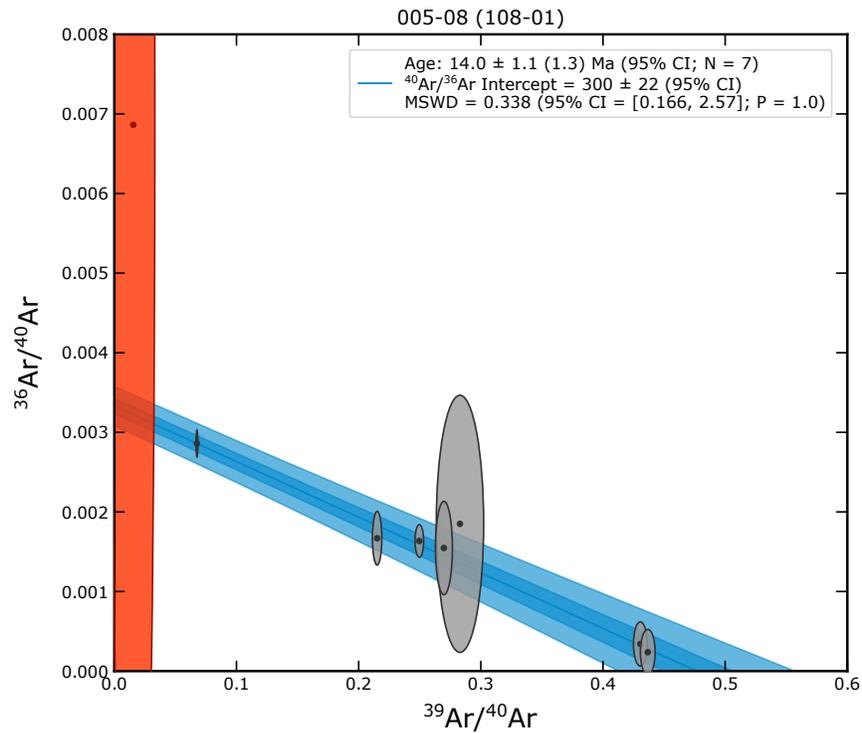


Figure S37. Inverse isochron for sample 005-08 (108-01), from the L&N mine. Red analyses have been excluded from the York regression. External age uncertainties are in parentheses.

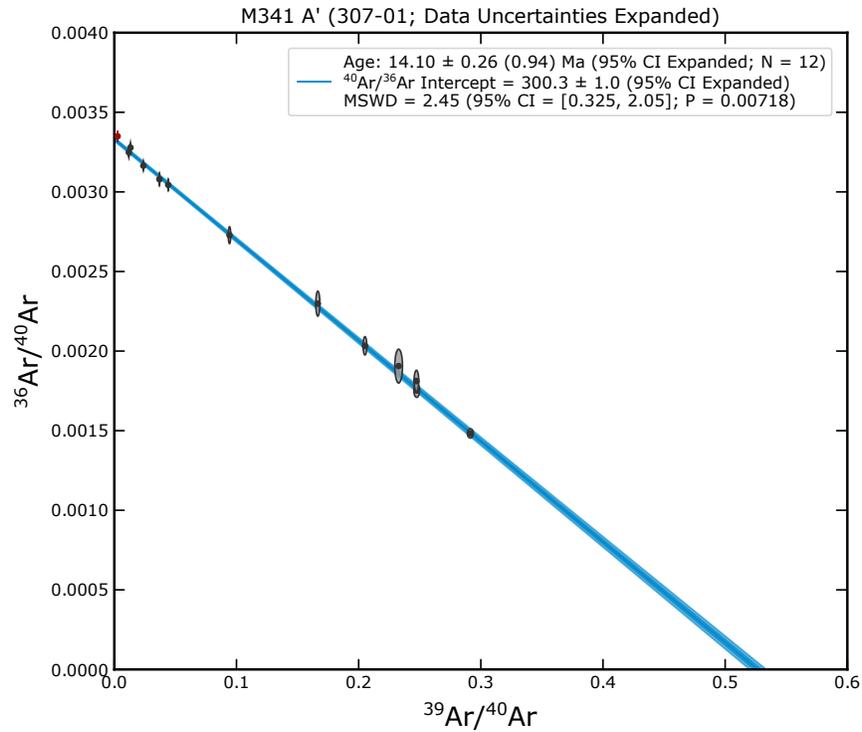


Figure S38. Inverse isochron for sample M341 A' (307-01), from the Christmas mine. Red analyses have been excluded from the York regression. External age uncertainties are in parentheses.

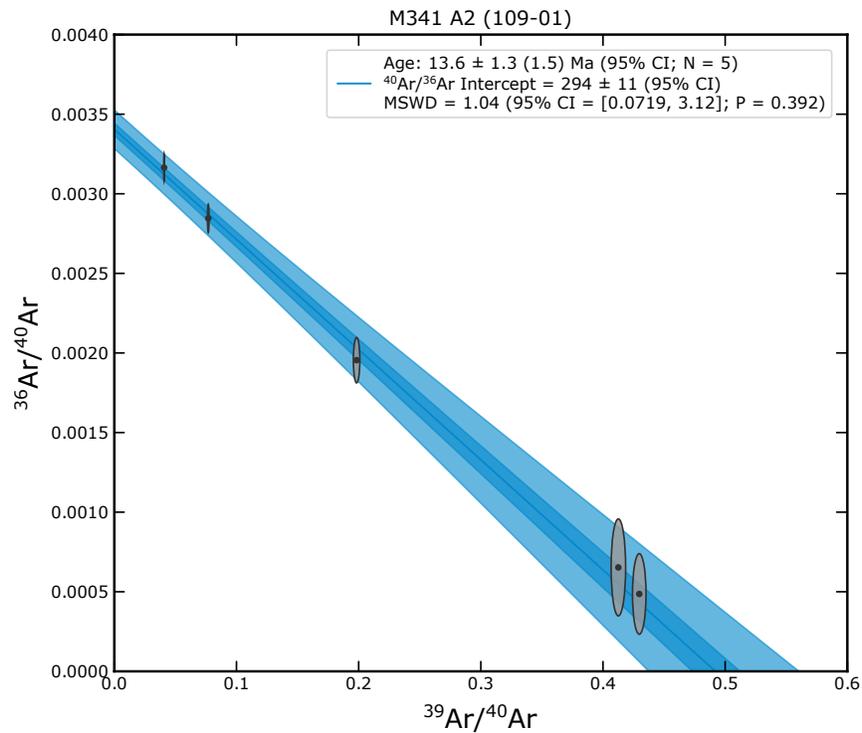


Figure S39. Inverse isochron for sample M341 A2 (109-01), from the Christmas mine. External age uncertainties are in parentheses.

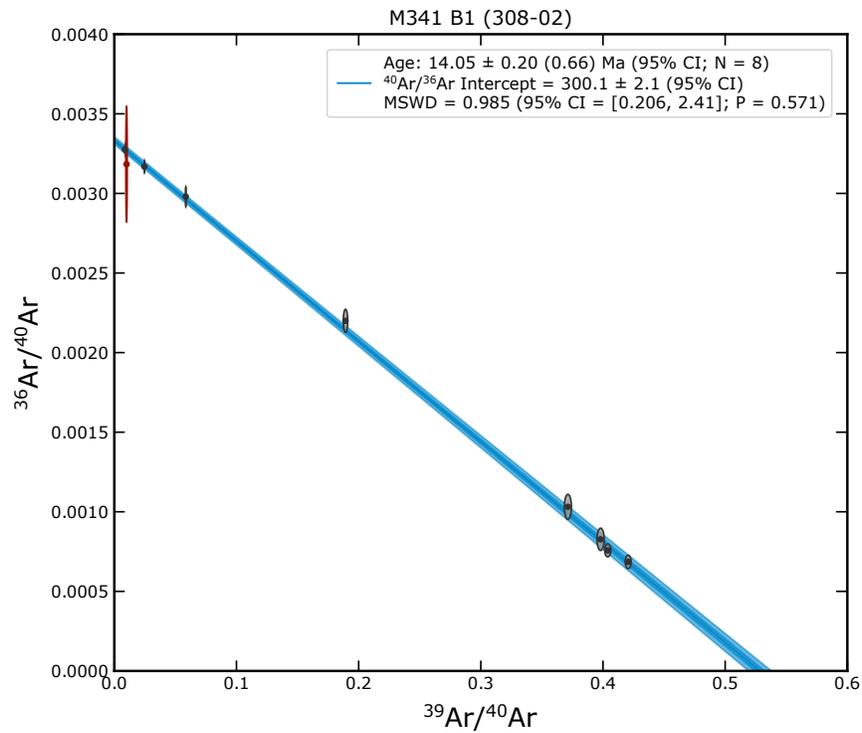


Figure S40. Inverse isochron for sample M341 B1 (308-02), from the Christmas mine. Red analyses have been excluded from the York regression. External age uncertainties are in parentheses.

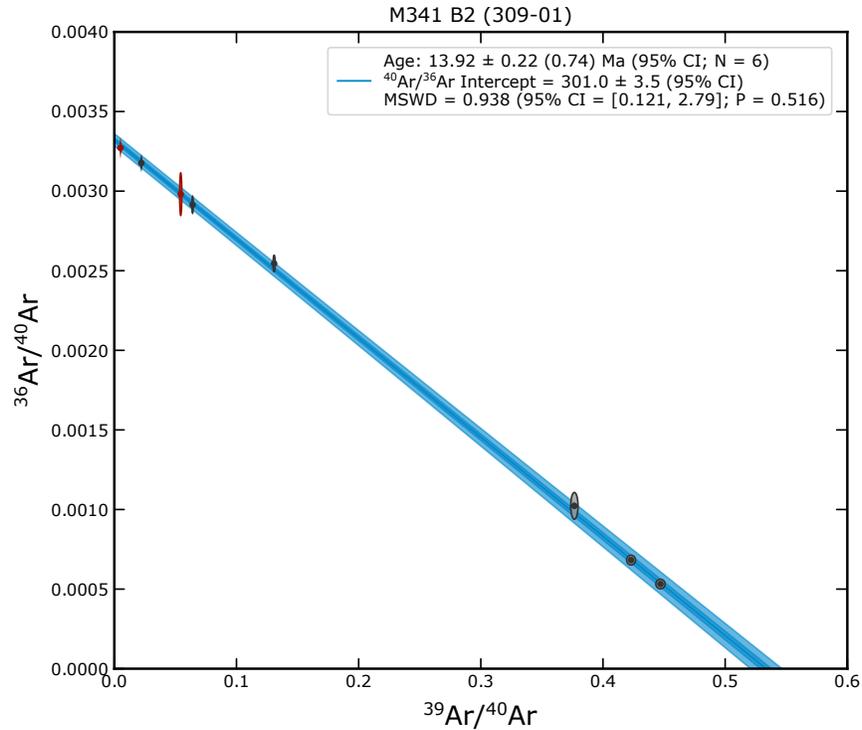


Figure S41. Inverse isochron for sample M341 B2 (309-01), from the Christmas mine. Red analyses have been excluded from the York regression. External age uncertainties are in parentheses.

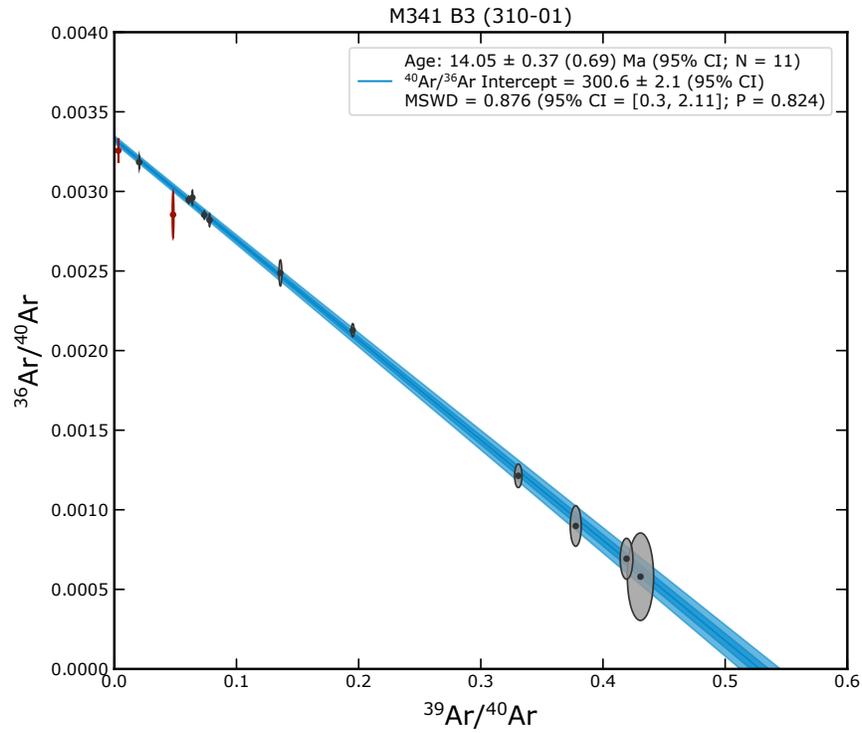


Figure S42. Inverse isochron for sample M341 B3 (310-01), from the Christmas mine. Red analyses have been excluded from the York regression. External age uncertainties are in parentheses.

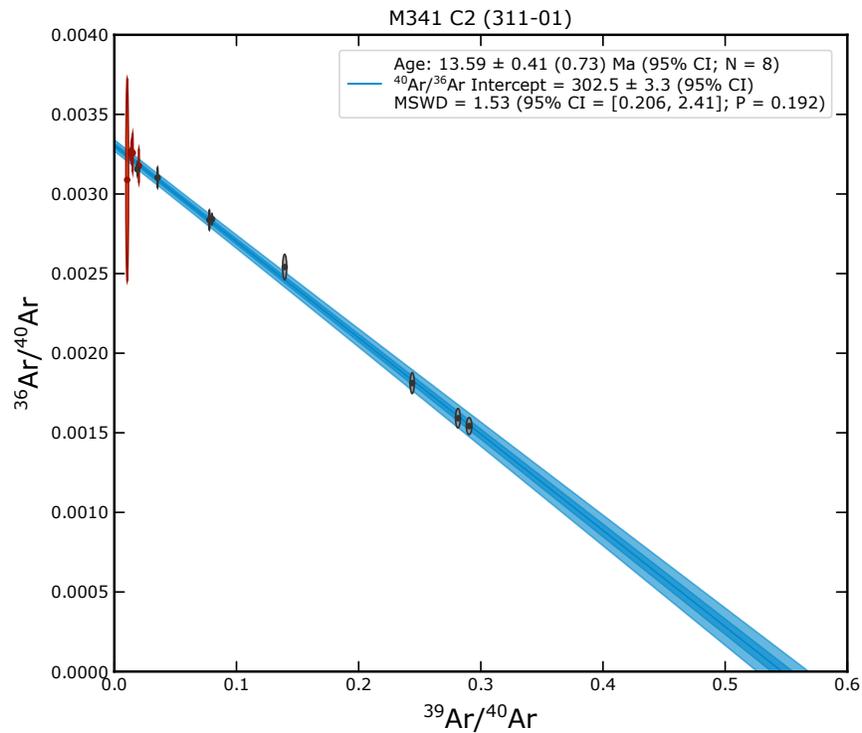


Figure S43. Inverse isochron for sample M341 C2 (311-01), from the Christmas mine. Red analyses have been excluded from the York regression. External age uncertainties are in parentheses.

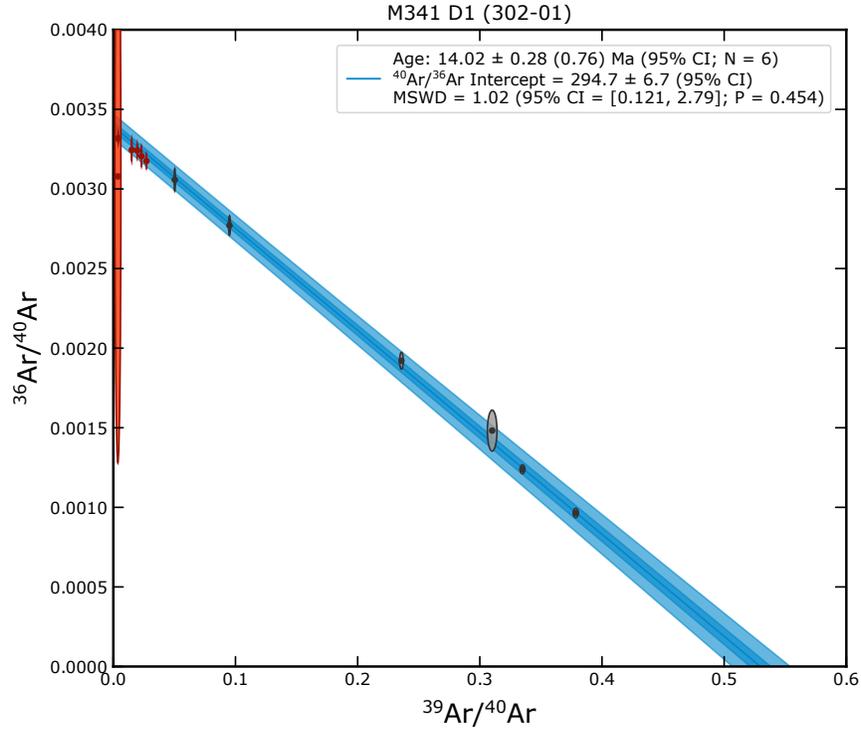


Figure S44. Inverse isochron for sample M341 D1 (302-01), from the Christmas mine. Red analyses have been excluded from the York regression. External age uncertainties are in parentheses.

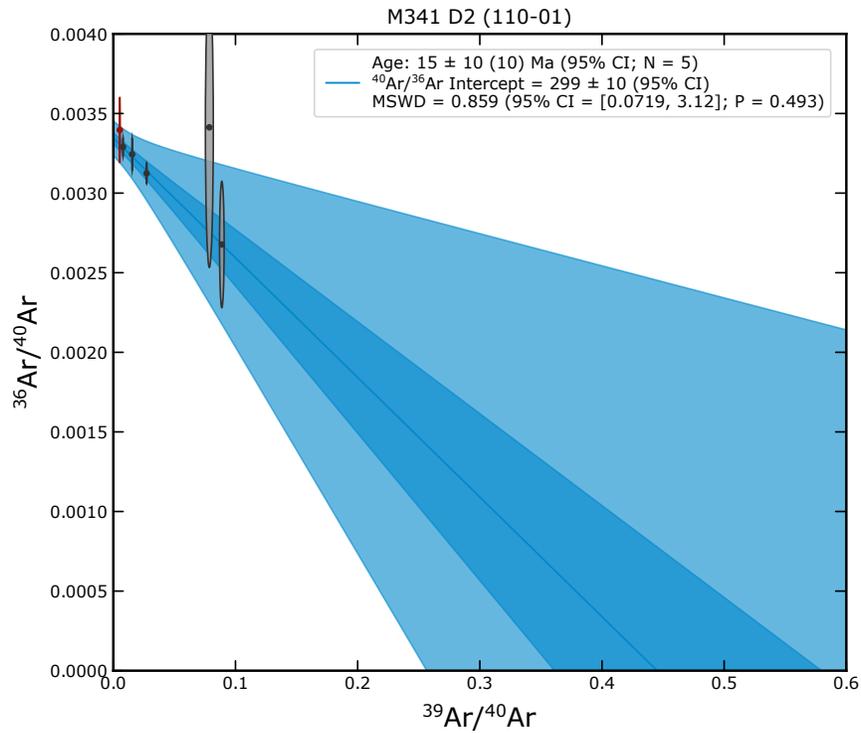


Figure S45. Inverse isochron for sample M341 D2 (110-01), from the Christmas mine. Red analyses have been excluded from the York regression. External age uncertainties are in parentheses.

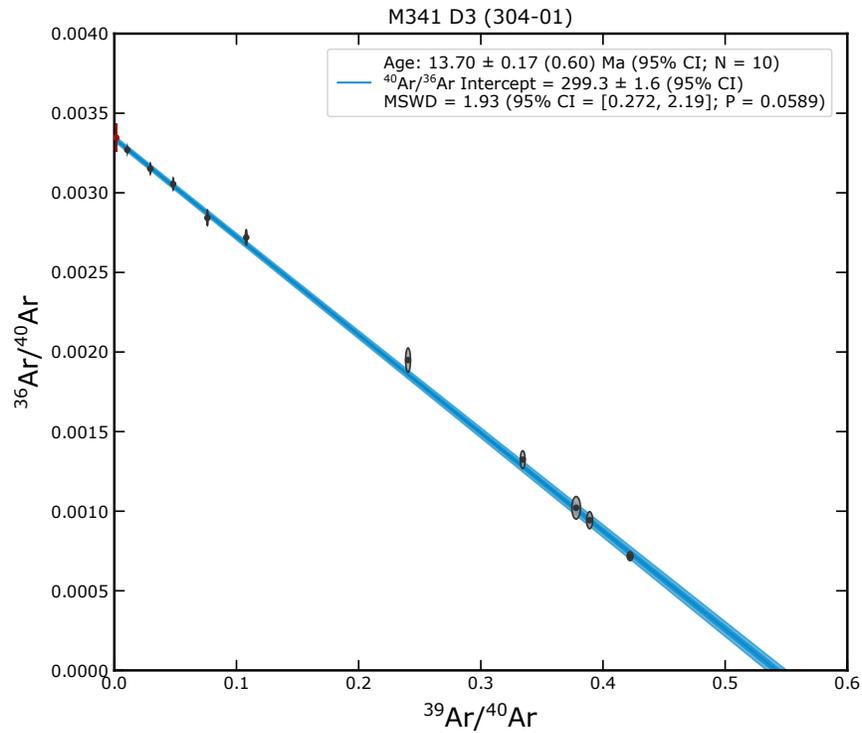


Figure S46. Inverse isochron for sample M341 D3 (304-01), from the Christmas mine. Red analyses have been excluded from the York regression. External age uncertainties are in parentheses.

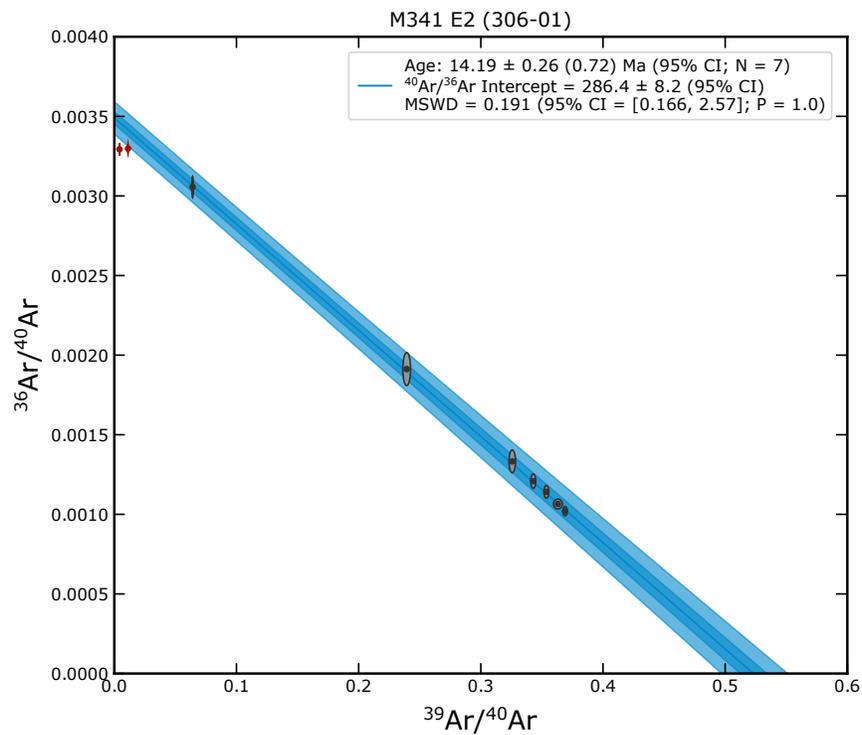


Figure S47. Inverse isochron for sample M341 E2 (306-01), from the Christmas mine. Red analyses have been excluded from the York regression. External age uncertainties are in parentheses.

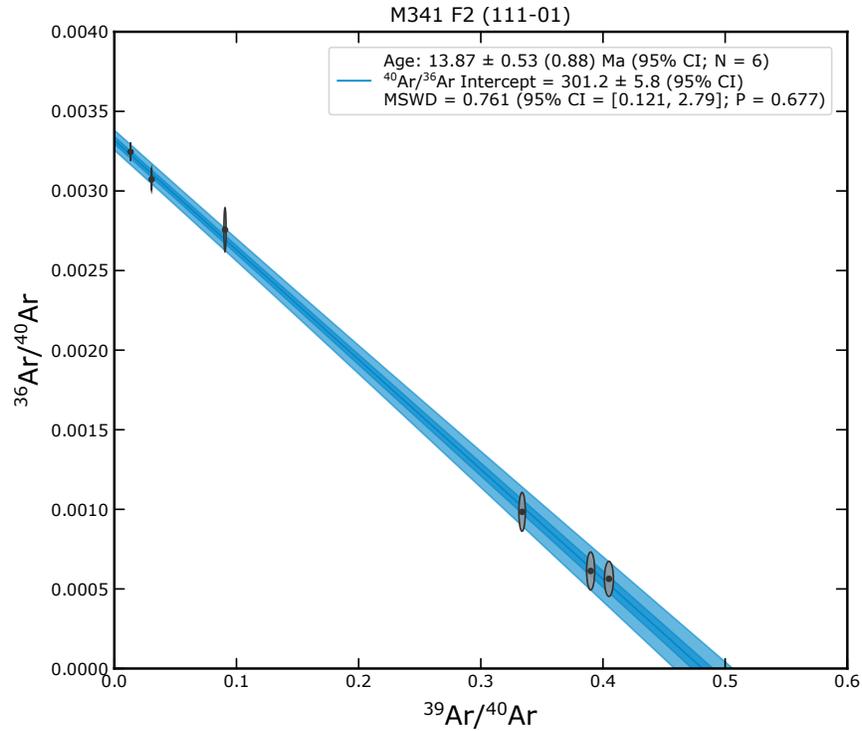


Figure S48. Inverse isochron for sample M341 F2 (111-01), from the Christmas mine. External age uncertainties are in parentheses.

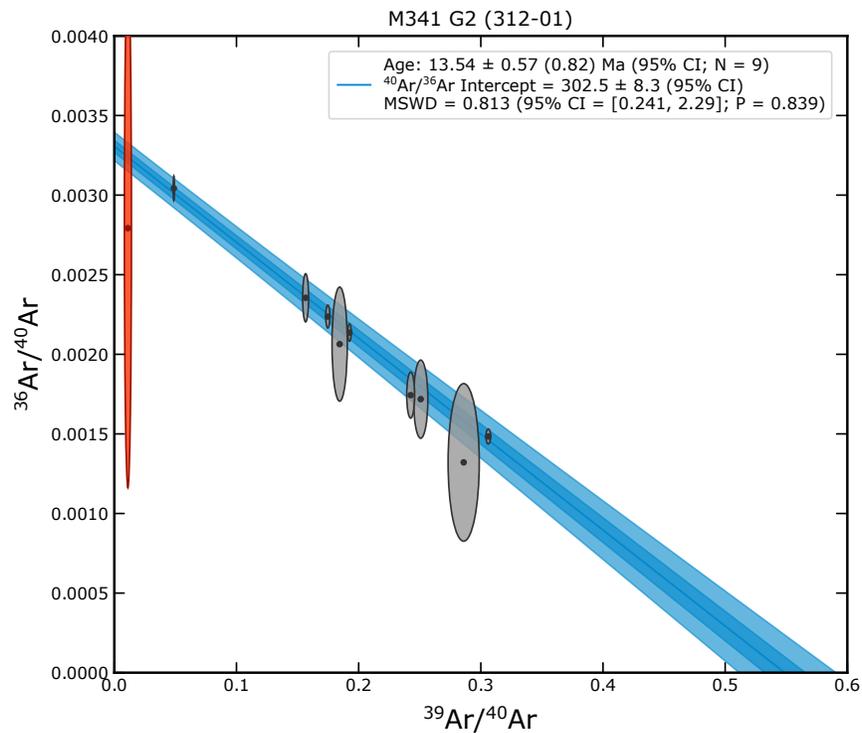


Figure S49. Inverse isochron for sample M341 G2 (312-01), from the Christmas mine. Red analyses have been excluded from the York regression. External age uncertainties are in parentheses.

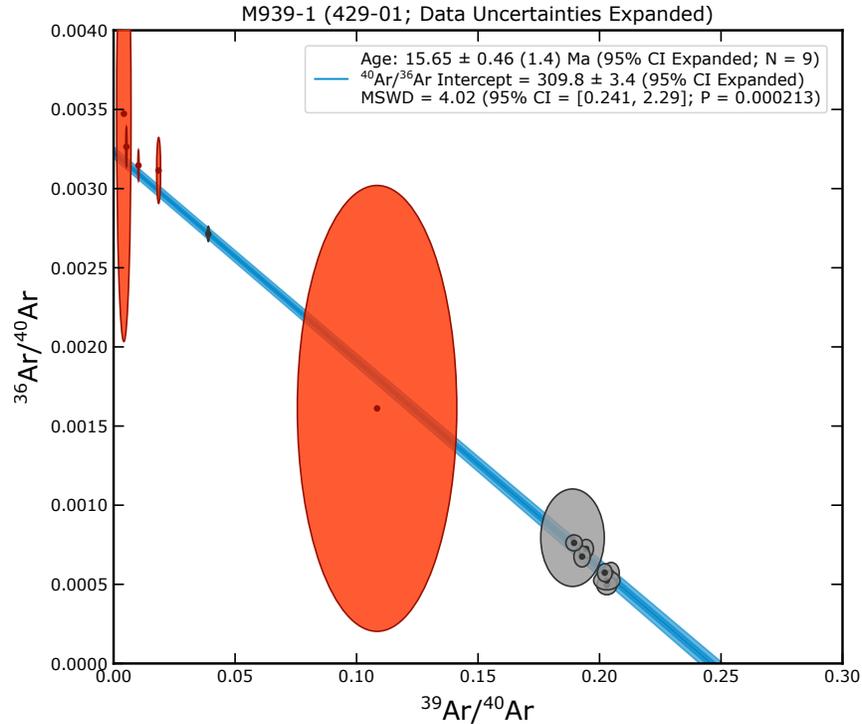


Figure S50. Inverse isochron for sample M939-1 (429-01), from the upper Mineral Products mine. Red analyses have been excluded from the York regression. External age uncertainties are in parentheses.

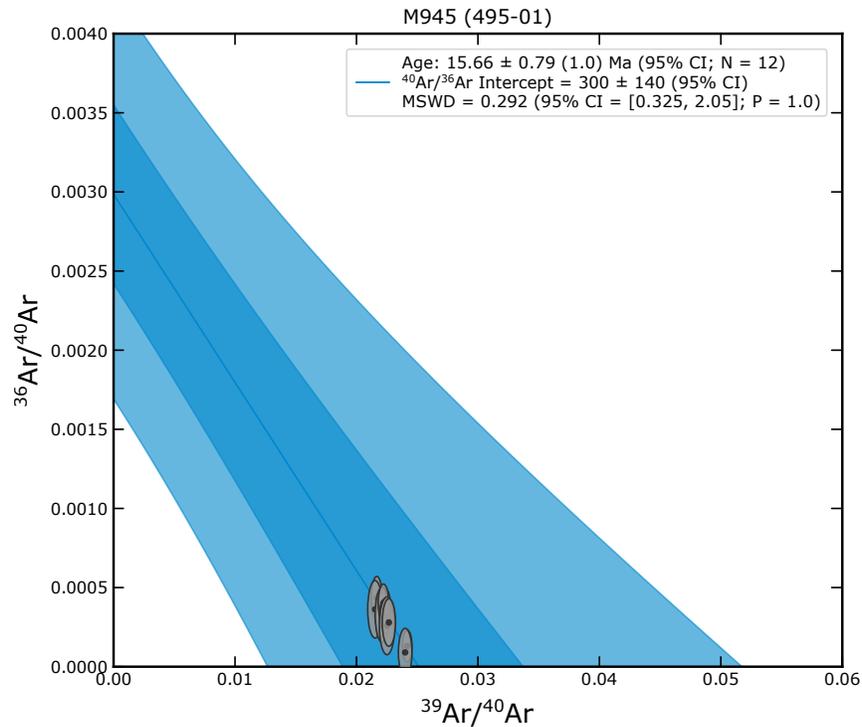


Figure S51. Inverse isochron for sample M945 (495-01), from the upper Mineral Products mine. External age uncertainties are in parentheses.

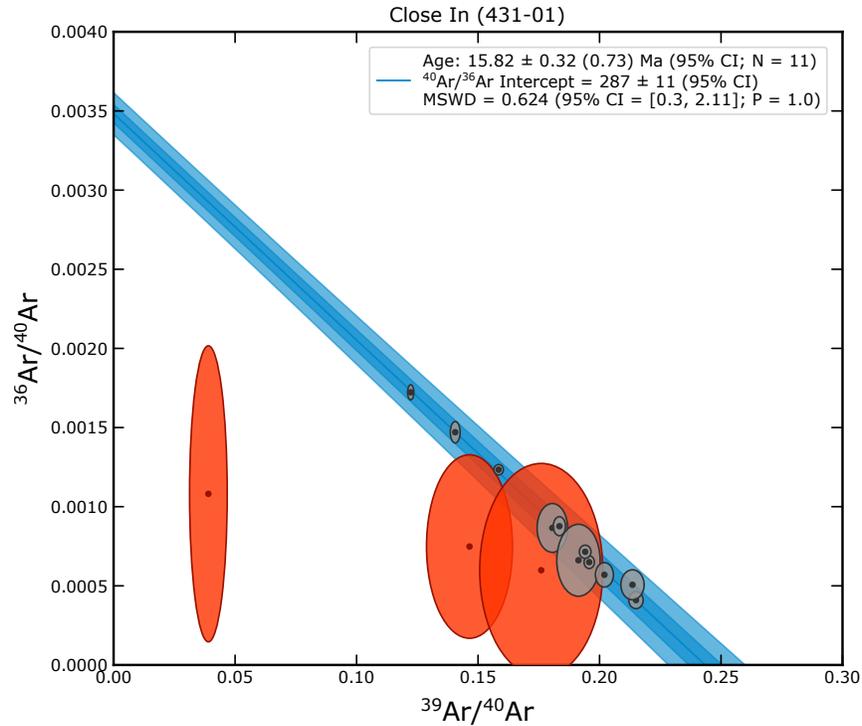


Figure S52. Inverse isochron for sample Close In (431-01), from the mine dump at the edge of the Sevier Valley. Red analyses have been excluded from the York regression. External age uncertainties are in parentheses.

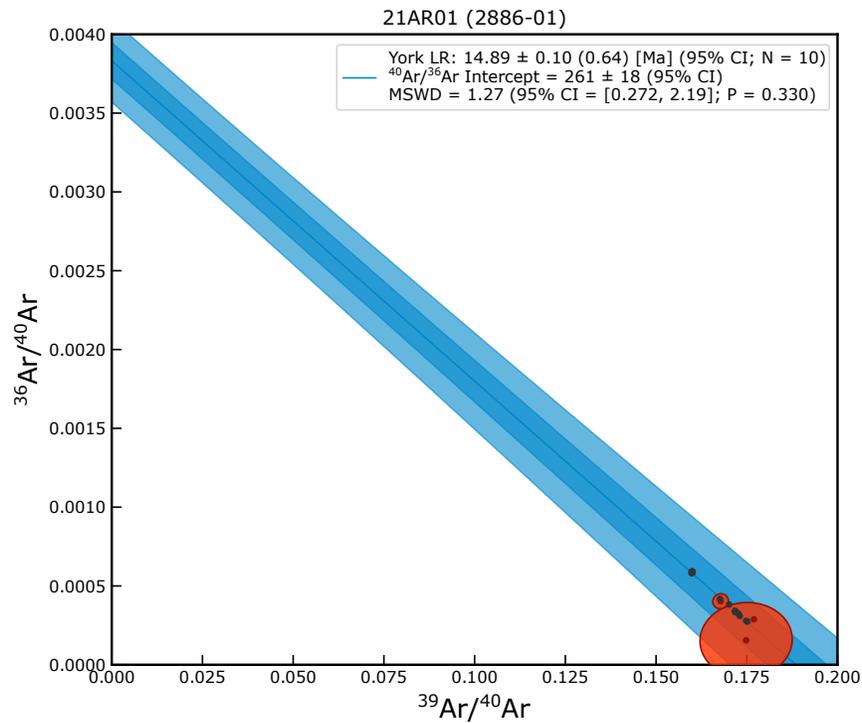


Figure S53. Inverse isochron for sample 21AR01 (2886-01), from the L&N mine. Red analyses have been excluded from the York regression. External age uncertainties are in parentheses.

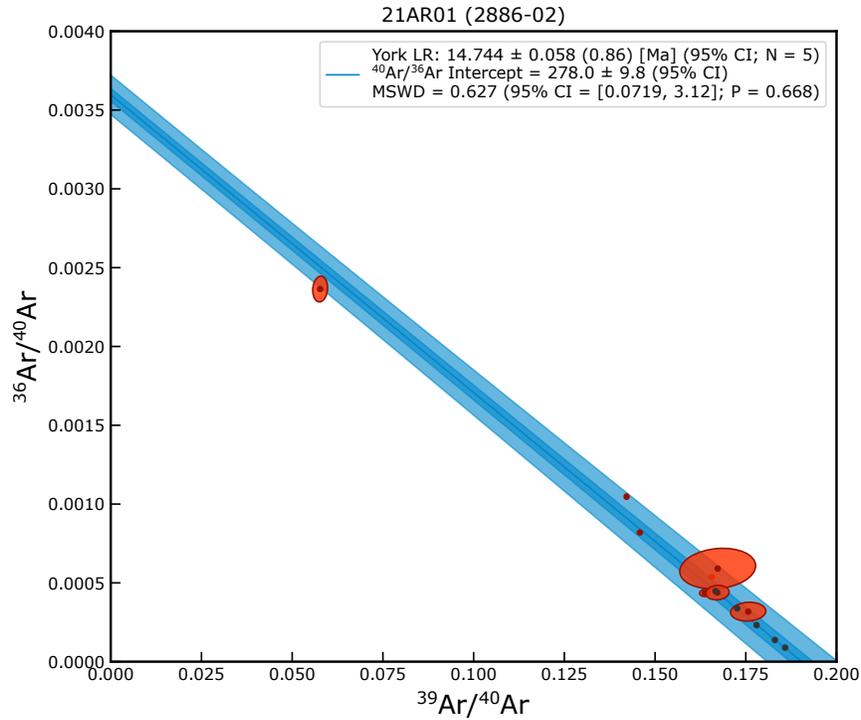


Figure S54. Inverse isochron for sample 21AR01 (2886-02), from the L&N mine. Red analyses have been excluded from the York regression. External age uncertainties are in parentheses.

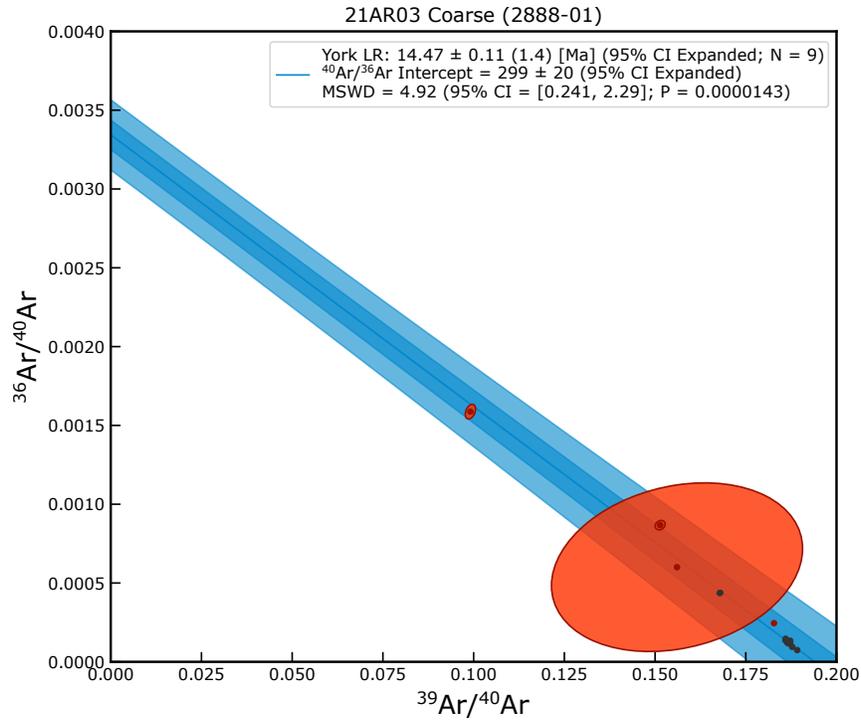


Figure S55. Inverse isochron for sample 21AR03 Coarse (2888-01), from the Christmas mine. Red analyses have been excluded from the York regression. External age uncertainties are in parentheses.

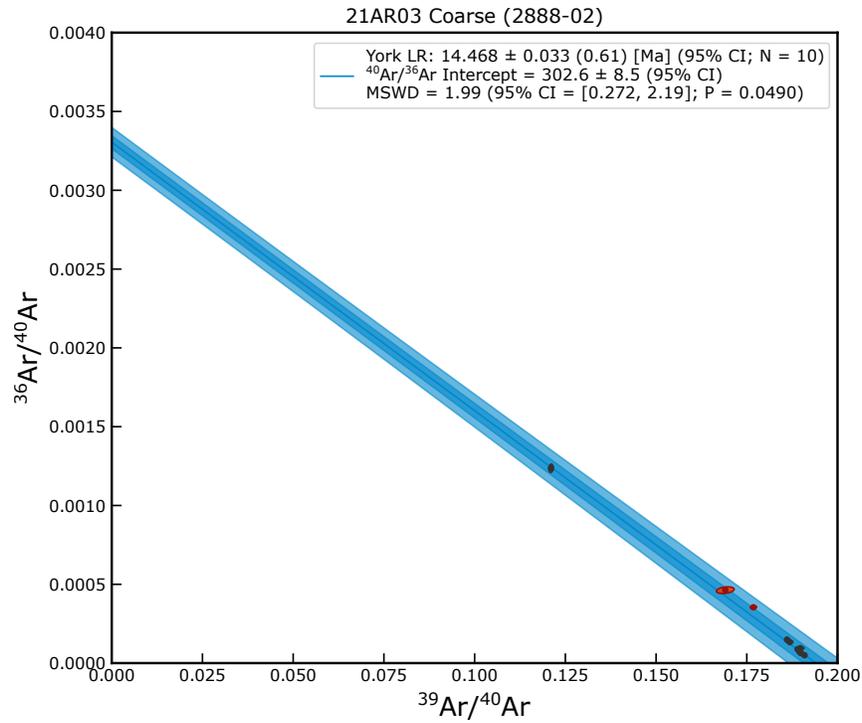


Figure S56. Inverse isochron for sample 21AR03 Coarse (2888-02), from the Christmas mine. Red analyses have been excluded from the York regression. External age uncertainties are in parentheses.

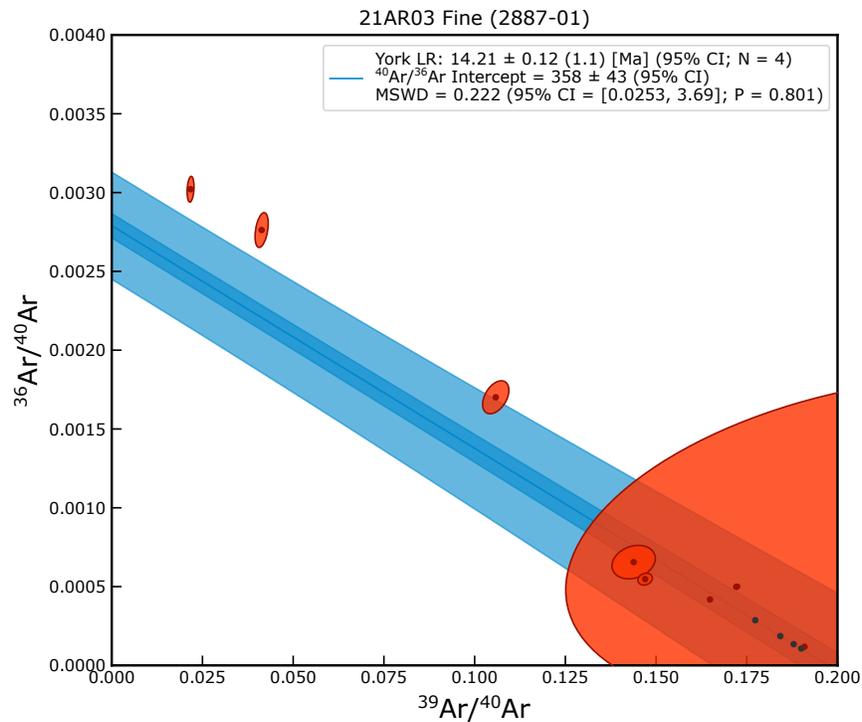


Figure S57. Inverse isochron for sample 21AR03 Fine (2887-01), from the Christmas mine. Red analyses have been excluded from the York regression. External age uncertainties are in parentheses.

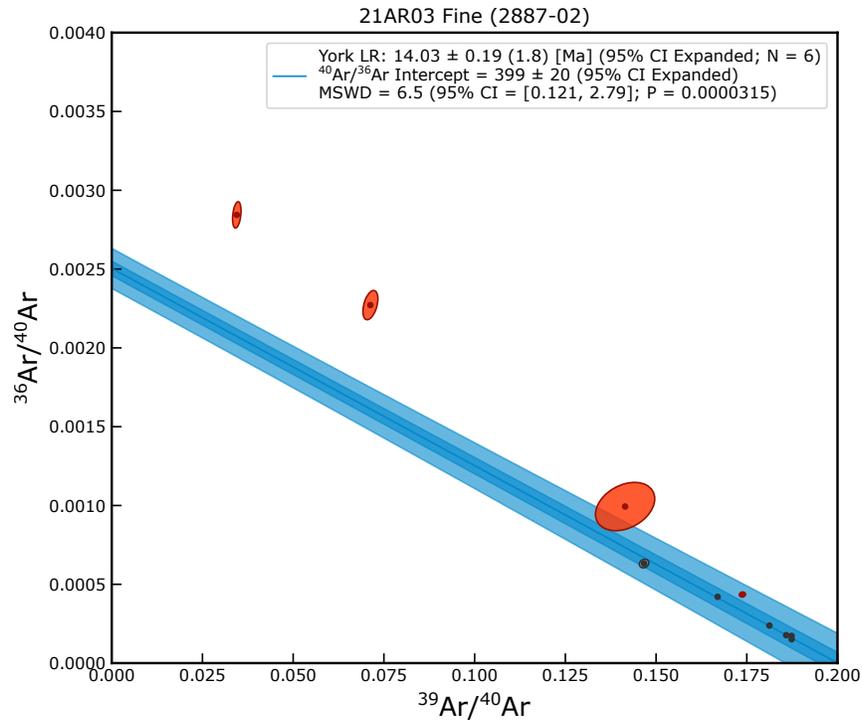


Figure S58. Inverse isochron for sample 21AR03 Fine (2887-02), from the Christmas mine. Red analyses have been excluded from the York regression. External age uncertainties are in parentheses.

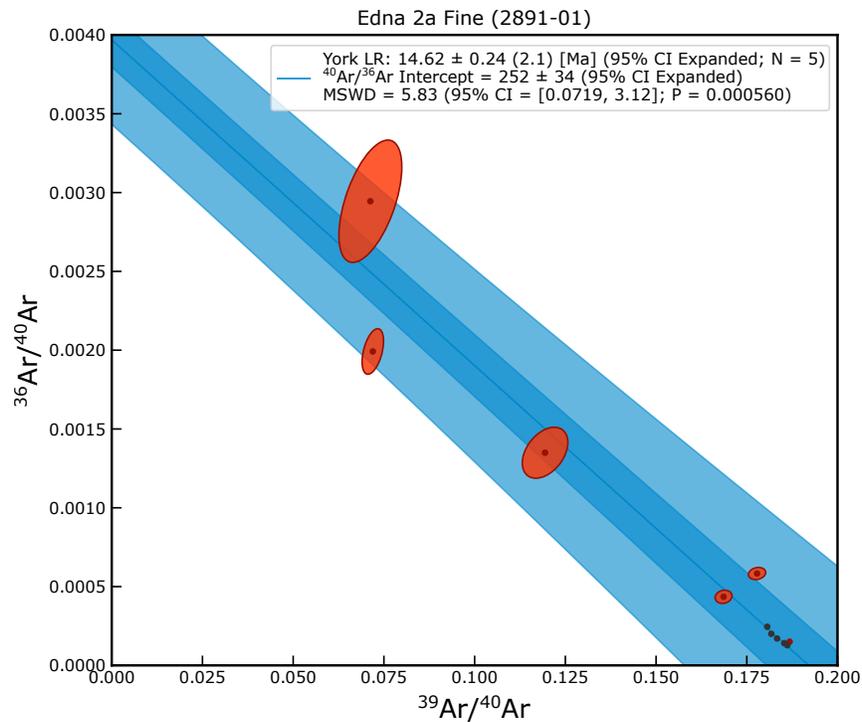


Figure S59. Inverse isochron for sample Edna 2a Fine (2891-01), from the Mt. Edna prospect. Red analyses have been excluded from the York regression. External age uncertainties are in parentheses.

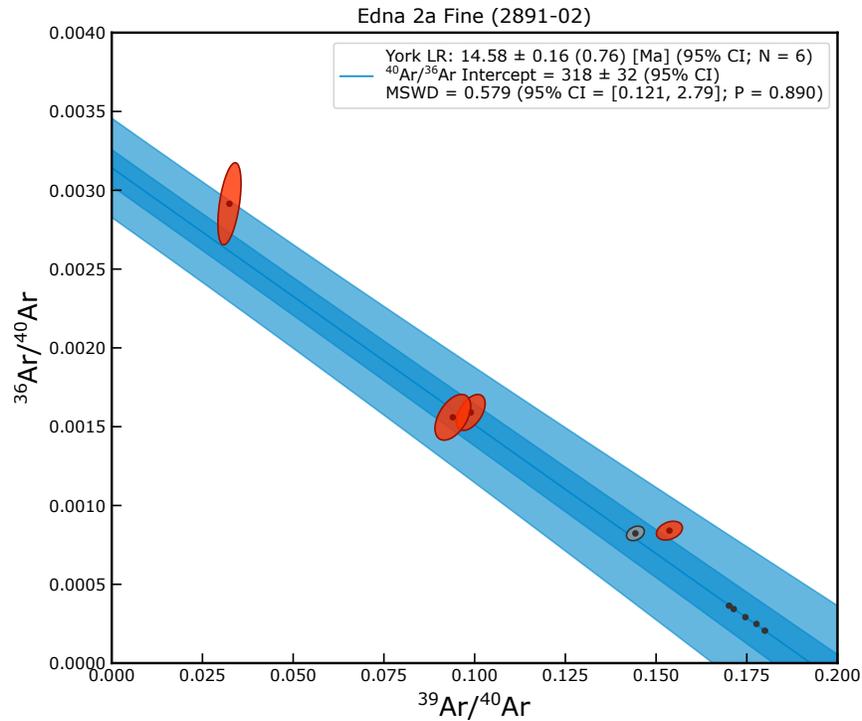


Figure S60. Inverse isochron for sample Edna 2a Fine (2891-02), from the Mt. Edna prospect. Red analyses have been excluded from the York regression. External age uncertainties are in parentheses.

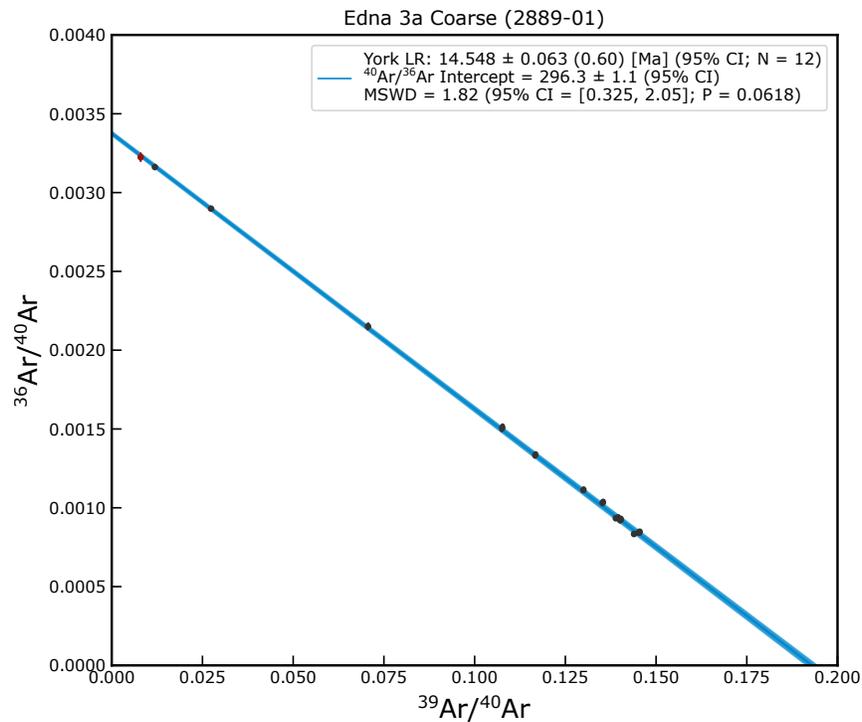


Figure S61. Inverse isochron for sample Edna 3a Coarse (2889-01), from the Mt. Edna prospect. Red analyses have been excluded from the York regression. External age uncertainties are in parentheses.

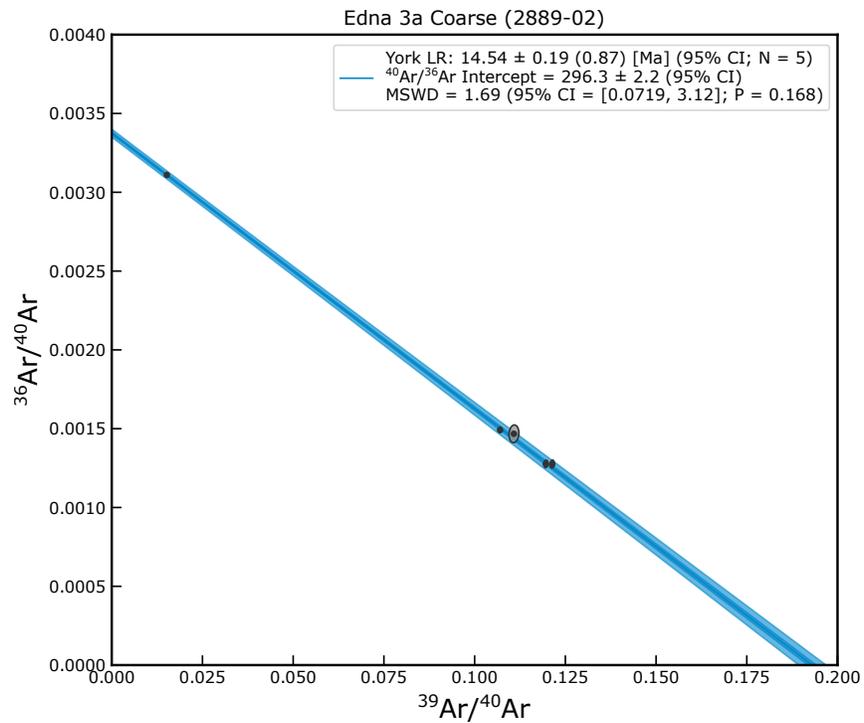


Figure S62. Inverse isochron for sample Edna 3a Coarse (2889-02), from the Mt. Edna prosect. Red analyses have been excluded from the York regression. External age uncertainties are in parentheses.

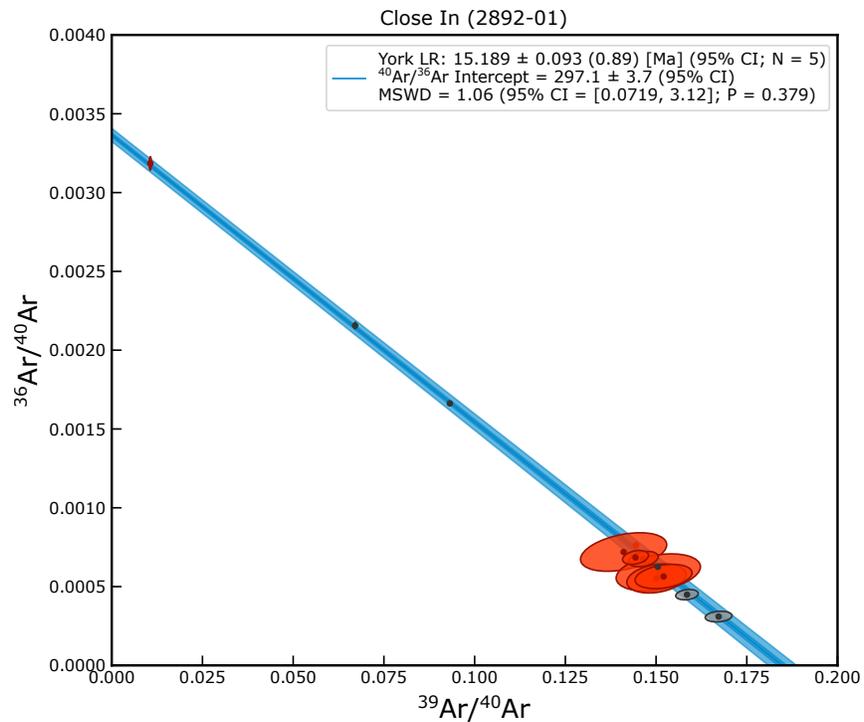


Figure S63. Inverse isochron for sample Close In (2892-01), from the mine dump at the edge of the Sevier Valley. Red analyses have been excluded from the York regression. External age uncertainties are in parentheses.

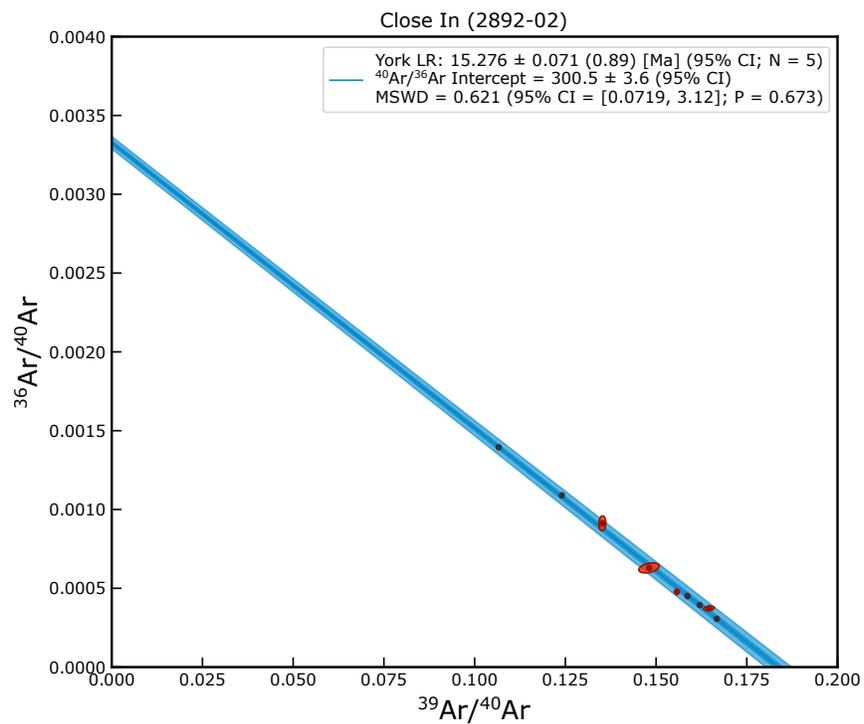


Figure S64. Inverse isochron for sample Close In (2892-02), from the mine dump at the edge of the Sevier Valley. Red analyses have been excluded from the York regression. External age uncertainties are in parentheses.

SHRIMP-RG U/Pb and Trace Element Data

M945-R: Mineral Products mine
Felsic dike

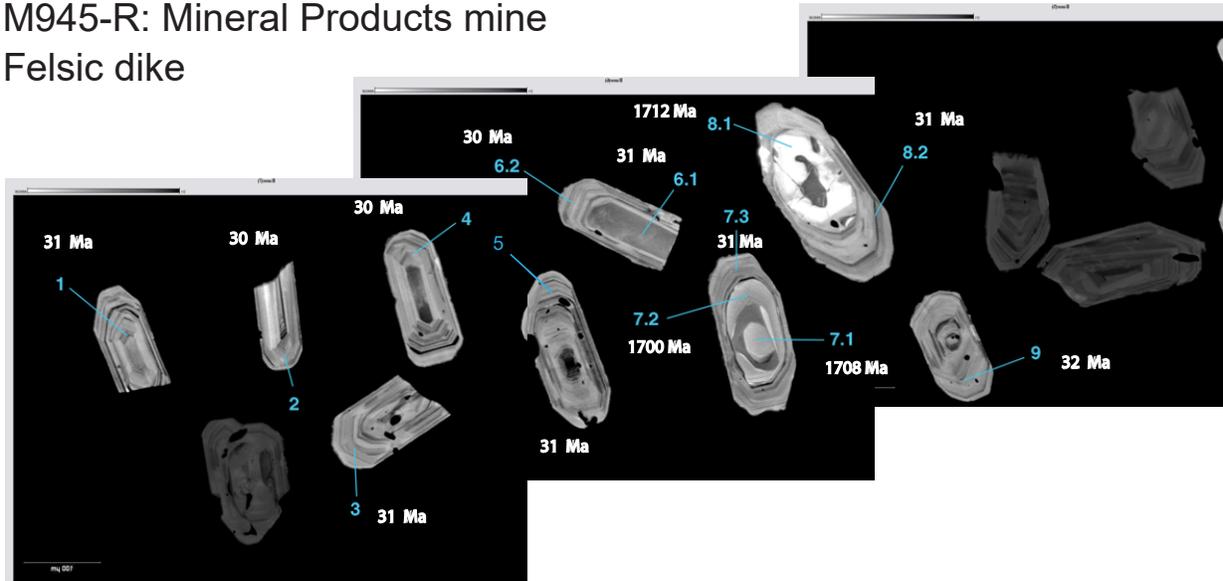


Figure S65. Cathodoluminescence images of zircon grains separated from sample M945-R and analyzed with the USGS/Stanford SHRIMP-RG. Spot locations and apparent ages are shown for each grain that was analyzed; Oligocene dates are $^{206}\text{Pb}/^{238}\text{U}$ ages, and dates for Proterozoic cores are $^{207}\text{Pb}/^{206}\text{Pb}$ ages.

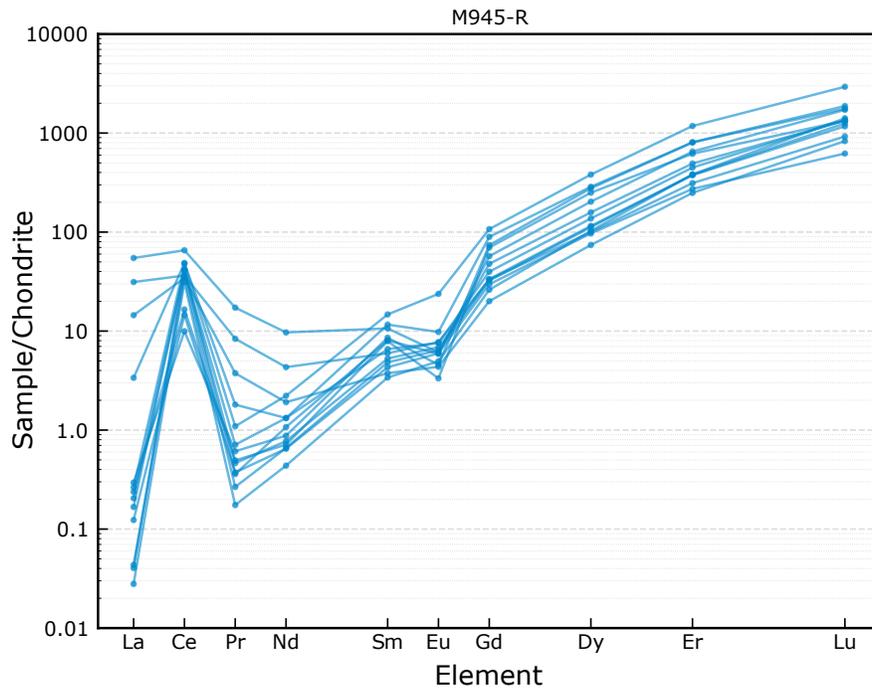


Figure S66. Rare earth element diagram for SHRIMP-RG analyses of zircons from sample M945-R, normalized to chondrites (McDonough and Sun, 1995).