**New microfossil and strontium isotope chronology used to identify the controls of Miocene reefs and related facies in NW Cyprus**

Supplementary material

Torin Cannings\*1, Elizabeth M. Balmer1, Giovanni Coletti2, Ryan B. Ickert3,4, Dick Kroon1, Isabella Raffi5 & Alastair H.F. Robertson1

*1School of GeoSciences, Grant Institute, University of Edinburgh, James Hutton Road, Edinburgh EH9 3FE, UK*

*2* *Dipartimento di Scienze dell'Ambiente e del Territorio e di Scienze della Terra, Università di Milano-Bicocca, 20126, Milano, Italy*

*3Scottish Universities Environmental Research Centre, Scottish Enterprise Technology Park, Rankine Avenue, East Kilbride, G75 0QF*

*4Department of Earth, Atmospheric, and Planetary Sciences, Purdue University. West Lafayette, IN, 47907. (present affiliation)*

*5Dipartimento di Ingegneria e Geotecnologie (InGeo), CeRSGeoUniversità degli Studi ‘G. d’Annunzio’ di Chieti-Pescara Campus Universitario, via dei Vestini 31 66013 Chieti Scalo, Italy*

\*Correspondence (torin.cannings@ed.ac.uk)

Here we present the data used during this study. This includes the collection locations and dating methods of samples used (Table S1), as well as the results of calcareous nannofossil biostratigraphy (Table S2), planktic foraminifera biostratigraphy (Table S3), and Sr isotope dating (Table S4). We also present the detailed method and error calculation method for the Sr isotope dating.

**Supplementary Table S1 -** Locations of samples used for dating in this study

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Sample Number** | | **Location** | | **Dating method use** | | |
| **CN biostratigraphy** | **Sr isotope dating** | **Benthic foraminifera biostratigraphy** |
| TC17 | 1 | N35º 01’ 34.2” | E032º 28’ 50.6” | **x** |  |  |
| TC17 | 5 | N35º 01’ 28.7” | E032º 27’ 55.5” |  | **x** |  |
| TC17 | 9 | N35º 00’ 43.6” | E032º 27’ 57.9” |  | **x** |  |
| TC17 | 10 | N35º 00’ 43.6” | E032º 27’ 57.9” |  | **x** |  |
| TC17 | 12 | N35º 00’ 27.5” | E032º 28’ 15.1” |  | **x** |  |
| TC17 | 13 | N35º 00’ 10.1” | E032º 28’ 27.7” |  | **x** |  |
| TC17 | 22 | N35º 00’ 11.3” | E032º 25’ 17.5” |  | **x** |  |
| TC17 | 26 | N35º 00’ 04.4” | E032º 25’ 17.7” | **x** |  |  |
| TC17 | 27 | N34º 59’ 59.1” | E032º 25’ 18.4” |  | **x** |  |
| TC17 | 28 | N35º 00’ 40.8” | E032º 23’ 34.9” |  | **x** |  |
| TC17 | 46 | N35º 03’ 49.9” | E032’ 19’ 24.4” |  |  | **x** |
| TC17 | 47 | N35º 03’ 49.9” | E032’ 19’ 24.4” |  |  | **x** |
| TC17 | 49 | N35º 00’ 32.4” | E032º 21’ 56.9” |  |  | **x** |
| TC17 | 50 | N34º 59’ 52.7” | E032º 24’ 14.1” |  | **x** |  |
| TC17 | 68 | N35º 01’ 28.6” | E032º 27’ 55.7” | **x** | **x** |  |
| TC17 | 69 | N35º 01’ 28.6” | E032º 27’ 55.7” |  | **x** |  |
| TC17 | 79 | N35º 01’ 28.6” | E032º 27’ 55.7” |  | **x** |  |
| TC17 | 80 | N35º 01’ 28.6” | E032º 27’ 55.7” | **x** |  |  |
| TC17 | 83 | N35º 00’ 57.5” | E032º 22’ 03.8” | **x** |  |  |
| TC17 | 84 | N35º 00’ 57.5” | E032º 22’ 03.8” | **x** |  |  |
| TC17 | 86 | N35º 00’ 57.5” | E032º 22’ 03.8” | **x** |  |  |
| TC17 | 87 | N35º 00’ 57.5” | E032º 22’ 03.8” | **x** |  |  |
| TC17 | 88 | N35º 00’ 57.5” | E032º 22’ 03.8” | **x** |  |  |
| TC17 | 89 | N35º 00’ 57.5” | E032º 22’ 03.8” | **x** |  |  |
| TC17 | 90 | N35º 00’ 57.5” | E032º 22’ 03.8” | **x** |  |  |
| TC17 | 92 | N35º 00’ 57.5” | E032º 22’ 03.8” | **x** | **x** |  |
| TC17 | 93 | N35º 00’ 57.5” | E032º 22’ 03.8” | **x** |  |  |
| TC17 | 94 | N35º 00’ 11.0” | E032º 25’ 19.6” | **x** | **x** |  |
| TC17 | 97 | N35º 00’ 11.0” | E032º 25’ 19.6” |  | **x** |  |
| TC17 | 100 | N35º 00’ 11.0” | E032º 25’ 19.6” |  | **x** |  |
| TC17 | 102 | N35º 00’ 11.0” | E032º 25’ 19.6” | **x** | **x** |  |
| TC17 | 103 | N35º 00’ 10.9” | E032º 25’ 19.9” | **x** |  |  |
| TC17 | 104 | N34º 58’ 36.5” | E032º 28’ 22.9” | **x** |  |  |
| TC17 | 109 | N34º 58’ 36.5” | E032º 28’ 22.9” | **x** |  |  |
| TC17 | 122 | N34º 58’ 36.5” | E032º 28’ 22.9” | **x** | **x** |  |
| TC17 | 124 | N34º 58’ 36.5” | E032º 28’ 22.9” | **x** |  |  |
| TC17 | 125 | N34º 58’ 36.5” | E032º 28’ 22.9” | **x** |  |  |
| TC17 | 127 | N34º 59’ 59.1” | E032º 24’ 05.1” | **x** |  |  |
| TC17 | 128 | N34º 59’ 59.1” | E032º 24’ 05.1” |  | **x** |  |
| TC17 | 130 | N34º 59’ 59.1” | E032º 24’ 05.1” | **x** |  |  |
| TC17 | 132 | N34º 55’ 43.7” | E032º 26’ 22.3” | **x** |  |  |
| TC17 | 135 | N34º 55’ 43.7” | E032º 26’ 22.3” | **x** |  |  |
| TC17 | 136 | N34º 55’ 51.4” | E032º 26’ 32.5” | **x** |  |  |
| TC17 | 140 | N34º 55’ 51.4” | E032º 26’ 32.5” | **x** |  |  |
| TC17 | 141 | N34º 55’ 42.7” | E032º 26’ 29.9” | **x** |  |  |
| TC17 | 143 | N34º 59’ 52.1” | E032º 24’ 12.7” | **x** |  |  |
| TC17 | 148 | N34º 55’ 49.3” | E032º 23’ 43.2” | **x** |  |  |
| TC17 | 151 | N34º 55’ 39.1” | E032º 23’ 55.7” | **x** |  |  |
| TC17 | 152 | N34º 55’ 38.9” | E032º 23’ 57.7” | **x** |  |  |
| TC17 | 153 | N34º 55’ 57.0” | E032º 24’ 04.6” | **x** |  |  |
| TC17 | 154 | N34º 55’ 57.0” | E032º 24’ 04.6” | **x** |  |  |
| TC17 | 155 | N35º 02’ 00.4” | E032º 30’ 12.1” | **x** |  |  |

**Supplementary Table S2 –** Results of nannofossil dating. Biozones and biochronology are from Backman *et al.* (2012). CNPL – Calcareous Nannofossil Pliocene. Semiquantitative abundance evaluations were obtained at magnification 1200× with a polarizing microscope. Total abundance: 1, *c.* 10; 2, *c.,* 20; and 3, >30 specimens in a single field of view. B – barren of nannofossils. Species abundances: 0, no specimen observed; A, >1 in specimen in each field of view; AA, dominant specimens in the assemblage; C, *c.* 1 specimen in 1–10 fields of view; F, *c.* 1 specimen every 10 fields of view; R, very few specimen in > 30 fields of view; VR, 1–2 specimens observed; cf., uncertain presence.



**Supplementary Table S3 –** Sample Locations and results of planktic foraminifera biostratigraphy

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Sample Number** | | **Location** | | **Characteristic planktic foraminifera assemblage** | **General position in Biozonation of Wade *et al.* 2011** | **General age** |
| TC17 | 130 | N34º 59’ 59.1” | E032º 24’ 05.1” | *O. universa, G. ruber, S. dehiscens* | PT1a | Early Pleistocene |
| TC17 | 127 | N34º 59’ 59.1” | E032º 24’ 05.1” | *O. universa, G. ruber, S. dehiscens* | PT1a | Early Pleistocene |
| TC17 | 128 | N34º 59’ 59.1” | E032º 24’ 05.1” | *O. universa, G. ruber, S. dehiscens* | PT1a | Early Pleistocene |
| TC17 | 26 | N35º 00’ 04.4” | E032º 25’ 17.7” | *O. universa, G. ruber, S. dehiscens, G extremus* | Pl4-Pl6 | Late Pliocene |
| TC17 | 27 | N34º 59’ 59.1” | E032º 25’ 18.4” | *O. universa, G. ruber, S. dehiscens, G extremus, N. pachyderma* | Pl4-Pl6 | Late Pliocene |
| TC17 | 94 | N35º 00’ 11.0” | E032º 25’ 19.6” | *O. universa, G. ruber, S. dehiscens, G extremus* | Pl4-Pl6 | Late Pliocene |
| TC17 | 2 | N35º 01’ 34.2” | E032º 28’ 50.6” | *O. universa, G. ruber, S. dehiscens, G extremus* | Pl4-Pl6 | Late Pliocene |
| TC17 | 102 | N35º 00’ 11.0” | E032º 25’ 19.6” | *O. universa, G. ruber, S. dehiscens, G extremus* | Pl4-Pl6 | Late Pliocene |
| TC17 | 79 | N35º 01’ 28.6” | E032º 27’ 55.7” | *O. universa, G. ruber, S. dehiscens, N. pachyderma,  G extremus* | Pl4-Pl6 | Late Pliocene |
| TC17 | 75 | N35º 01’ 28.6” | E032º 27’ 55.7” | *O. universa, G. ruber, S. dehiscens, G extremus* | Pl4-Pl6 | Late Pliocene |
| TC17 | 97 | N35º 00’ 11.0” | E032º 25’ 19.6” | *S. seminulina, S. dehiscens* | Pl1a-Pl4 | Late Miocene- Early Pliocene |
| TC17 | 80 | N35º 01’ 28.6” | E032º 27’ 55.7” | *G. margaritae, S. seminulina, S. dehiscens* | Pl1a- Pl2 | Late Miocene- Early Pliocene |
| TC17 | 155 | N35º 02’ 00.4” | E032º 30’ 12.1” | *G. margaritae, S. seminulina, S. dehiscens* | Pl1a- Pl2 | Late Miocene- Early Pliocene |
| TC17 | 100 | N35º 00’ 11.0” | E032º 25’ 19.6” | *G. margaritae, S. seminulina, S. dehiscens, G. crassaformis* | Pl1a- Pl2 | Late Miocene- Early Pliocene |
| TC17 | 11 | N35º 00’ 43.6” | E032º 27’ 57.9” | *G. margaritae, S. seminulina, S. dehiscens* | Pl1a- Pl2 | Late Miocene- Early Pliocene |
| TC17 | 71 | N35º 01’ 28.6” | E032º 27’ 55.7” | *G. margaritae, S. seminulina, S. dehiscens* | Pl1a- Pl2 | Late Miocene- Early Pliocene |
| TC17 | 72 | N35º 01’ 28.6” | E032º 27’ 55.7” | *G. margaritae, S. seminulina, S. dehiscens* | Pl1a- Pl2 | Late Miocene- Early Pliocene |
| TC17 | 103 | N35º 00’ 10.9” | E032º 25’ 19.9” | *G. margaritae, S. seminulina, S. dehiscens* | Pl1a- Pl2 | Late Miocene- Early Pliocene |
| TC17 | 9 | N35º 00’ 43.6” | E032º 27’ 57.9” | *G. margaritae, S. seminulina, S. dehiscens* | Pl1a- Pl2 | Late Miocene- Early Pliocene |
| TC17 | 28 | N35º 00’ 40.8” | E032º 23’ 34.9” | *G. margaritae, S. seminulina, S. dehiscens* | Pl1a- Pl2 | Late Miocene- Early Pliocene |
| TC17 | 10 | N35º 00’ 43.6” | E032º 27’ 57.9” | *G. margaritae, S. seminulina, S. dehiscens* | Pl1a- Pl2 | Late Miocene- Early Pliocene |
| TC17 | 21 | N35º 00’ 10.9” | E032º 25’ 16.1” | *G. margaritae, S. seminulina, S. dehiscens* | Pl1a- Pl2 | Late Miocene- Early Pliocene |
| TC17 | 22 | N35º 00’ 11.3” | E032º 25’ 17.5” | *G. margaritae, S. seminulina, S. dehiscens* | Pl1a- Pl2 | Late Miocene- Early Pliocene |
| TC17 | 69 | N35º 01’ 28.6” | E032º 27’ 55.7” | *G. margaritae, S. seminulina, S. dehiscens* | Pl1a- Pl2 | Late Miocene- Early Pliocene |
| TC17 | 13 | N35º 00’ 10.1” | E032º 28’ 27.7” | *G. margaritae, S. seminulina, S. dehiscens* | Pl1a- Pl2 | Late Miocene- Early Pliocene |
| TC17 | 67 | N34º 50’ 32.6” | E032º 28’ 05.4” | *G. margaritae, S. seminulina, S. dehiscens, G. nepenthes* | Pl1a- Pl2 | Late Miocene- Early Pliocene |
| TC17 | 124 | N34º 58’ 36.5” | E032º 28’ 22.9” | *G. margaritae, S. seminulina, S. dehiscens* | Pl1a- Pl2 | Late Miocene- Early Pliocene |
| TC17 | 50 | N34º 59’ 52.7” | E032º 24’ 14.1” | *G. margaritae, S. seminulina, S. dehiscens* | Pl1a- Pl2 | Late Miocene- Early Pliocene |
| TC17 | 68 | N35º 01’ 28.6” | E032º 27’ 55.7” | *G. margaritae, S. seminulina, S. dehiscens* | Pl1a- Pl2 | Late Miocene- Early Pliocene |
| TC17 | 126 | N34º 59’ 59.1” | E032º 24’ 05.1” | *G. margaritae, S. seminulina, S. dehiscens* | Pl1a- Pl2 | Late Miocene- Early Pliocene |
| TC17 | 5 | N35º 01’ 28.7” | E032º 27’ 55.5” | *G. margaritae, S. seminulina, S. dehiscens* | Pl1a- Pl2 | Late Miocene- Early Pliocene |
| TC17 | 12 | N35º 00’ 27.5” | E032º 28’ 15.1” | *G. margaritae, S. seminulina, G. nepenthes* | M14-Pl1a | Late Miocene- Early Pliocene |
| TC17 | 104 | N34º 58’ 36.5” | E032º 28’ 22.9” | *O. universa, G. nepenthes, N. acostaensis* | M13a - Pl1a | Late Miocene- Early Pliocene |
| TC17 | 109 | N34º 58’ 36.5” | E032º 28’ 22.9” | *O. universa, G. nepenthes, N. acostaensis* | M13a - Pl1a | Late Miocene- Early Pliocene |
| TC17 | 122 | N34º 58’ 36.5” | E032º 28’ 22.9” | *O. universa, G. nepenthes, N. acostaensis* | M13a - Pl1a | Late Miocene- Early Pliocene |
| TC17 | 125 | N34º 58’ 36.5” | E032º 28’ 22.9” | *O. universa, G. nepenthes, N. acostaensis* | M13a - Pl1a | Late Miocene- Early Pliocene |
| TC17 | 16 | N34º 59’ 31.5” | E032º 28’ 45.3” | *O. universa, G. nepenthes, N. acostaensis* | M13a - Pl1a | Late Miocene- Early Pliocene |
| TC17 | 52 | N34º 58’ 51.7” | E032º 24’ 25.7” | *O. universa, G. nepenthes, N. acostaensis* | M13a - Pl1a | Late Miocene- Early Pliocene |
| TC17 | 1 | N35º 01’ 34.2” | E032º 28’ 50.6” | *O. universa, G. nepenthes, N. acostaensis* | M13a - Pl1a | Late Miocene- Early Pliocene |
| TC17 | 92 | N35º 00’ 57.5” | E032º 22’ 03.8” | *O. universa, G. nepenthes, N. acostaensis* | M13a - Pl1a | Late Miocene- Early Pliocene |
| TC17 | 93 | N35º 00’ 57.5” | E032º 22’ 03.8” | *O. universa, G. nepenthes, N. acostaensis* | M13a - Pl1a | Late Miocene- Early Pliocene |
| TC17 | 132 | N34º 55’ 43.7” | E032º 26’ 22.3” | *Globoquadrina spp., P. siakensis, P. mayeri, O. suturalis* | M6-M11 | Middle Miocene |
| TC17 | 135 | N34º 55’ 43.7” | E032º 26’ 22.3” | *Globoquadrina spp., P. siakensis, O. suturalis* | M6-M11 | Middle Miocene |
| TC17 | 83 | N35º 00’ 57.5” | E032º 22’ 03.8” | *Globoquadrina spp., P. siakensis, O. suturalis* | M6-M11 | Middle Miocene |
| TC17 | 84 | N35º 00’ 57.5” | E032º 22’ 03.8” | *Globoquadrina spp., P. siakensis, O. suturalis* | M6-M11 | Middle Miocene |
| TC17 | 86 | N35º 00’ 57.5” | E032º 22’ 03.8” | *Globoquadrina spp., P. siakensis, O. suturalis* | M6-M11 | Middle Miocene |
| TC17 | 151 | N34º 55’ 39.1” | E032º 23’ 55.7” | *O. universa, Globoquadrina spp., P. siakensis, O. suturalis* | M6-M11 | Middle Miocene |
| TC17 | 152 | N34º 55’ 38.9” | E032º 23’ 57.7” | *O. universa, Globoquadrina spp., P. siakensis, O. suturalis* | M6-M11 | Middle Miocene |
| TC17 | 153 | N34º 55’ 57.0” | E032º 24’ 04.6” | *O. universa, Globoquadrina spp., P. siakensis, O. suturalis* | M6-M11 | Middle Miocene |
| TC17 | 154 | N34º 55’ 57.0” | E032º 24’ 04.6” | *O. universa, Globoquadrina spp., P. siakensis, O. suturalis* | M6-M11 | Middle Miocene |
| TC17 | 141 | N34º 55’ 42.7” | E032º 26’ 29.9” | *O. universa, Globoquadrina spp., P. siakensis, O. suturalis* | M6-M11 | Middle Miocene |
| TC17 | 142 | N34º 59’ 52.1” | E032º 24’ 12.7” | *O. universa, Globoquadrina spp., P. siakensis, O. suturalis* | M6-M11 | Middle Miocene |
| TC17 | 143 | N34º 59’ 52.1” | E032º 24’ 12.7” | *O. universa, Globoquadrina spp., P. siakensis, O. suturalis* | M6-M11 | Middle Miocene |
| TC17 | 87 | N35º 00’ 57.5” | E032º 22’ 03.8” | *O. universa, Globoquadrina spp., P. siakensis, O. suturalis* | M6-M11 | Middle Miocene |
| TC17 | 88 | N35º 00’ 57.5” | E032º 22’ 03.8” | *O. universa, Globoquadrina spp., P. siakensis, O. suturalis* | M6-M11 | Middle Miocene |
| TC17 | 89 | N35º 00’ 57.5” | E032º 22’ 03.8” | *O. universa, Globoquadrina spp., P. siakensis, O. suturalis* | M6-M11 | Middle Miocene |
| TC17 | 90 | N35º 00’ 57.5” | E032º 22’ 03.8” | *O. universa, Globoquadrina spp., P. siakensis, O.suturalis* | M6-M11 | Middle Miocene |
| TC17 | 136 | N34º 55’ 51.4” | E032º 26’ 32.5” | *Globoquadrina spp., P. siakensis, O. suturalis* | M6-M11 | Middle Miocene |
| TC17 | 140 | N34º 55’ 51.4” | E032º 26’ 32.5” | *Globoquadrina spp., P. siakensis, O. suturalis* | M6-M11 | Middle Miocene |
| TC17 | 148 | N34º 55’ 49.3” | E032º 23’ 43.2” | *Globoquadrina spp., P. siakensis, O. suturalis* | M6-M11 | Middle Miocene |

**87Sr/86Sr isotopic preparation and method**

Carbonate samples were weighed into PFA vials (~25 µg) and leached in ammonium acetate to remove groundwater salts and displace contaminant strontium on exchangeable sites (Bailey *et al.* 2000). The remaining material was rinsed twice in deionized water and then dissolved in dilute HCl (prepared by sub-boiling distillation in PFA (Mattinson, 1972). Strontium was separated from matrix elements using strontium-specific resin (Horwitz *et al.* 1991,1992), using a nitric acid extraction chemical procedure, adapted from Pin *et al.* (1994), in which samples are loaded in 8 molar (M) HNO3, cleaned in sequential steps of 8M HNO3 and 3M HNO3, and strontium- eluted in 0.01 M HNO3. After ion exchange chemistry, the samples were loaded onto purified Re filaments in a Ta- emitter solution (Birck, 1986). Total procedural blanks yielded values of better than 350 pg, which are negligible relative to the amount of sample run (> 1µg).

Isotopic analyses were made on a VG-Sector-54 thermal ionization mass spectrometer using a three cycle dynamic multicollector routine and an exponential mass fractionation correction relative to 86Sr/88Sr = 0.1194 (Nier, 1938; Moore *et al.* 1982; Steiger and Jager, 1977; Hans *et al.* 2013). Filaments were slowly heated to 2.4 A, focussing and filament current was adjusted to achieve a stable 1E-11 A ion beam on 88Sr. Analyses are typically run for 15 blocks of 10 cycles (150 ratios), for approximately 1.5 hours. Rubidium interferences were monitored but were negligible. Repeated measurements of reference material NBS987 at similar run conditions during the period over which these analyses were made yielded a value of 0.710258 (+/-0.000028 2SD, n=47), within uncertainty of the convention value of 0.71025, and indicates that the measurement repeatability is close to with the within-run uncertainty.

Strontium isotopic ages were calculated using the LOWESS Sr isotope Look-Up Table (Version 4: 08/04) (McArthur, *et al.* 2001; McArthur & Howarth, 2004). To help produce consistent age results, where possible, the same samples were used for planktic foraminiferal biostratigraphy and/or calcareous nannofossil dating. Where age-diagnostic species were absent from a selected isotopic dating sample, additional samples were dated using microfossils from stratigraphically-near samples of similar facies.

The total combined errors were calculated from a combination of the uncertainties of the Sr isotopic analyses, and the errors in the LOWESS Sr curve. The method of McCay *et al.* (2013) which uses 2 standard deviations of the analytical error, combined with the empirical error of the LOWESS “look-up table” to find the largest error range. This method gives a maximum age obtained from the subtracting 2σ (standard deviation) from the mean isotopic value and finding the age for this value on the ‘upper age limit curve’ of the LOWESS Sr Curve and a minimum age obtained from the adding 2σ (standard deviation) to the mean isotopic value and finding the age for this value on the ‘lower age limit curve’ of the LOWESS Sr Curve.

**Supplementary Table S4 –** Results of strontium Isotope analysis, age results and error

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sample** | **87Sr/86Sra** | **Minimum**  **Age (Ma)b** | **Calculated**  **Age (Ma)c** | **Maximum**  **Age (Ma)d** |
| TC1792 | 0.708909 | 7.47 | 9.33 | 10.37 |
| TC1728 | 0.709053 | 2.05 | 4.01 | 5.42 |
| TC1750 | 0.709035 | 2.70 | 5.03 | 5.82 |
| TC17128 | 0.709087 | 1.30 | 1.93 | 3.58 |
| TC1794 | 0.709075 | 1.48 | 2.33 | 4.68 |
| TC1722 | 0.709044 | 2.34 | 4.7 | 5.64 |
| TC1727 | 0.709081 | 1.38 | 2.15 | 4.29 |
| TC1797 | 0.709059 | 1.83 | 3.28 | 5.24 |
| TC17100 | 0.709054 | 2.02 | 3.88 | 5.39 |
| TC17102 | 0.709134 | 0.41 | 1.072 | 1.53 |
| TC1705 | 0.709030 | 3.07 | 5.19 | 5.91 |
| TC1768 | 0.709033 | 2.81 | 5.09 | 5.86 |
| TC1769 | 0.709042 | 2.40 | 4.78 | 5.68 |
| TC1779 | 0.709062 | 1.74 | 2.93 | 5.14 |
| TC1709 | 0.709053 | 2.05 | 4.01 | 5.33 |
| TC1710 | 0.709046 | 2.28 | 4.6 | 5.6 |
| TC1712 | 0.709014 | 4.67 | 5.63 | 6.16 |
| TC17122 | 0.708987 | 5.55 | 6.1 | 6.98 |
| TC1713 | 0.709041 | 2.44 | 4.82 | 5.7 |

aMeasurements of SRM987 during the course of this work yield an average value of 0.710258+/-0.000028. (n=47; 2 standard deviations).

bMaximum age (Ma) obtained from the mean isotopic value − 2σ (standard deviation) on the upper limit age curve.

cMean age (Ma) obtained from the mean isotopic value on the mean age curve.

dMinimum age (Ma) obtained from the mean isotopic value + 2σ on the lower limit age curve.

**References**

Bailey, T.R. McArthur, J.M. Prince, H. & Thirlwall, M.F. 2000. Dissolution methods for strontium isotope stratigraphy: whole rock analysis. *Chemical Geology*, **167**, 313–319, <https://doi.org/10.1016/S0009-2541(99)00235-1>.

Birck, J.L. 1986. Precision K-Rb-Sr isotopic analysis: Application to Rb-Sr chronology. *Chemical Geology*, **56**, 73–83. doi:10.1016/0009-2541(86)90111-7

Hans, U. Kleine, T. Bourdon, B. 2013. Rb–Sr chronology of volatile depletion in differentiated protoplanets: BABI, ADOR and ALL revisited. *Earth and Planetary Science Letters,* **374**, 204–214. doi:10.1016/j.epsl.2013.05.029

Horwitz, E.P. Dietz, M.L. Fisher, D.E. 1991. Separation and preconcentration of strontium from biological, environmental, and nuclear waste samples by extraction chromatography using a crown ether. *Analytical Chemistry*, **63**, 522–525. doi:10.1021/ac00005a027

Horwitz, E.P. Chiarizia, R. Dietz, M.L. 1992. A Novel Strontium-Selective Extraction Chromatographic Resin\*. *Solvent Extraction and Ion Exchange,* **10**, 313–336. doi:10.1080/07366299208918107

Mattinson, J.M. 1972. Preparation of hydrofluoric, hydrochloric, and nitric acids at ultralow lead levels. *Analytical Chemistry*, **44**, 1715–1716. doi:10.1021/ac60317a032

McArthur, J. M. Howarth, R. J. & Bailey, T. R. 2001. Strontium isotope stratigraphy: LOWESS version 3: best fit to the marine Sr-isotope curve for 0–509 Ma and accompanying look-up table for deriving numerical age. *Journal of Geology*, **109,** 155-170.

McArthur, J. M. & Howarth, R. J. 2004. Sr-isotope stratigraphy. *In:*  Gradstein, F.M. Ogg, J.G. and Smith, A.G. (Eds.), A Geological Timescale 2004, *Cambridge University Press, Cambridge* 589

﻿McCay, G.A., Robertson, A.H.F., Kroon, D., Raffi, I., Ellam, R.M. & Necdet, M. 2013. Stratigraphy of Cretaceous to Lower Pliocene sediments in the northern part of Cyprus based on comparative 87Sr/86Sr isotopic, nannofossil and planktonic foraminiferal dating. *Geological Magazine*, **150**, 333–359, https://doi.org/10.1017/S0016756812000465.

Moore, L.J. Murphy, T.J. Barnes, I.L. Paulsen, P.J. 1982. Absolute isotopic abundance ratios and atomic weight of a reference sample of strontium. *Journal of Research of the National Bureau of Standards* **87**, 1–8. doi:10.6028/jres.087.001

Nier, A.O. 1938. The Isotopic Constitution of Strontium, Barium, Bismuth, Thallium and Mercury. *Physics Reviews,* **54**, 275–278. https://doi.org/10.1103/PhysRev.54.275

Pin, C. Briot, D. Bassin, C. Poitrasson, F. 1994. Concomitant separation of strontium and samarium-neodymium for isotopic analysis in silicate samples, based on specific extraction chromatography. *Analytica Chimica Acta*, **298**, 209–217. doi:10.1016/0003-2670(94)00274-6

Steiger, R.H. Jäger, E. 1977. Subcommission on geochronology: Convention on the use of decay constants in geo- and cosmochronology. *Earth and Planetary Science Letters,* **36**, 359–362. doi:10.1016/0012-821X(77)90060-7

Wade, B. S. Pearson, P. N. Berggren, W. A. & Pälike, H. 2011. Review and revision of Cenozoic tropical planktonic foraminiferal biostratigraphy and calibration to the geomagnetic polarity and astronomical time scale. *Earth-Science Reviews*, **104,** 111-142.