Lesson 8: Teacher Reference 2

Rock Composition Modifications

The first and fifth columns of data in the table below are derived from the age of the rock reported in Table 1 on page 10 of *Modes of rifting in magma-rich settings: Tectono-magmatic evolution of Central Afar*. The ages reported in the article are based on measured amounts of K-40 and Ar-40 for the samples shown here. The calculated columns were derived by the OpenSciEd authors of this lesson, using a known half-life for K-40 to Ar-40 of 1250 million years.

		Calculated: extrapolated for educational purposes in this lesson		Reported	Summary of accuracy of the data students are using	
Sample	Label	Ratio of K-40 / Ar-40	Ratio of K-40 now / K-408 at formation	Age of rock (mya)	Label location of this sample shown on map is accurate	Ratio of these two elements is **exact or is simplified** based on other results
AF12-02	C1	624.00	0.99840	2.89	yes	Simplified based on other results
AF12-11	D1	399.00	0.99750	4.51	yes	Simplified based on other results
AF13-98	D2	218.78	0.99545	8.23	yes	Simplified based on other results
AF13-102	E1	73.404	0.98656	24.4	yes	Simplified based on other results

The first and fifth column of data in the table below are reported in table 2 on page 11 of *Modes of rifting in magma-rich settings: Tectono-magmatic evolution of Central Afar*. The ages reported in the article were based on measured amounts of U-238, Th-232, Sm-147, and He-4, for the samples presented here. The authors of this lesson recalculated the data based on the known half-life of U-238 to He-4, which is 4,500 million years, and they disregarded the contribution of any other intermediate decay products. This simplification was made so students can use the results of their investigation to calculate the estimated age of these rocks themselves, based on a single radioactive parent/daughter decay relationship.

		Calculated: extrapolated for educational purposes in this lesson		Reported	Summary of accuracy of the data students are using	
Sample	Label	Ratio of U-238 / He-4	Ratio of U-238 now / U-238 at formation	age of rock (mya)	Label location of this sample shown on map is accurate	Ratio of these two elements is **exact or is simplified** based on other results
AF12-15	B1	1611.9	0.99938	4.0	yes	Simplified based on other results

AF12-21	D3	868.57	0.99885	7.5	yes	Simplified based on other results

The first, second, and fifth columns of data in the table below are values reported from the map and related key (Figure 2) on page 6 of *Modes of rifting in magma-rich settings: Tectono-magmatic evolution of Central Afar*. The key cites the original published study for the sites chosen for the related student activity sheet. That original published study is included as a reference below. All the original published studies appear to have used the K-40/Ar-40 decay dating method, except for the F2* site, which used an Ar-40–Ar-39 dating method. For the purposes of the student activity, the reported age of rock was converted to an equivalent age based on a ratio of K-40/Ar-40 to reduce the complexity of the data analysis. In the revision, this may end up being replaced with an equivalent K-Ar ratio as time permits, to find a related rock sample site reported in the research base using this method. The calculated columns were derived by the OpenSciEd authors of this lesson, using a known half-life for K-40 to Ar-40 of 1250 million years.

		Calculated: extrapolated for educational purposes in this lesson		Reported	Summary of accuracy of the data students are using	
Citation made to this other source	Site label	Ratio of K-40 / Ar-40	Ratio of K-40 now / K-40 at formation	age of rock (my)	Label location of this sample shown on map is accurate?	Ratio of these two elements is **exact or is simplified** based on other results
Kuntz et al., 1975	D4	294.86	0.99662	6.1	yes	Simplified based on other results
Barberi et al., 1975	E3	78.618	0.98744	22.8	yes	Simplified based on other results
	E2	71.622	0.98623	25.0	yes	Simplified based on other results
Coulié et al., 2003	F1	61.267	0.98394	29.2	yes	Simplified based on other results
	F3	57.824	0.98300	30.92	yes	Simplified based on other results
Ukstins et al., 2002	F2*	60.387	0.98371	29.61	yes	Simplified based on other results
Kidane et al., 2003	B3	2271.7	0.99956	0.79	yes	Simplified based on other results
	B4	2126.7	0.99953	0.84	yes	Simplified based on other results
	C2	924.93	0.99892	1.94	yes	Simplified based on other results
	C5	883.96	0.99887	2.03	yes	Simplified based on other results
	A1	6249.0	0.99984	0.290	yes	Simplified based on other results

Lahitte et al., 2003a & 2003b	A2	6249.0	0.99984	0.290	yes	Simplified based on other results
	A3	5554.6	0.99982	0.332	yes	Simplified based on other results
	B2	1885.8	0.99947	0.959	yes	Simplified based on other results
	B5	3845.2	0.99974	0.489	yes	Simplified based on other results
	C3	557.65	0.99821	3.222	yes	Simplified based on other results
Lahitte et al., 2001	A4	14284	0.99993	0.12	yes	Simplified based on other results
Zumbo et al., 1985	C4	942.39	0.99894	1.90	yes	Simplified based on other results

The first, third, and fifth columns of data in the table below are the first four samples reported in Table 1 of *Zircon U–Pb ages, δ18O and whole-rock Nd isotopic compositions of the Dire Dawa Precambrian basement, eastern Ethiopia: Implications for the assembly of Gondwana.* These samples were measured at different locations than those indicated in G1, G2, G3, G4. They are samples taken at 9°27'02.5"N, 41°49'59.4"E, which is south of the area shown in the student map. Rocks that are from the same formation are all the same age. These samples were taken from similar basement rock types as shown in G1, G2, G3, and G4 at Afar. This is why the OpenSciEd authors of this lesson included them in the new locations on the student map--so students could have data to draw comparisons to determine how much older the surrounding basement rock is in the region they are studying (Afar) than in the rest of the samples. The intent in the revisions was to replace this data with actual sample sites taken from the basement rock on the Afar region map.

			Measured	Calculated: extrapolated based on prior column	Reported	Summary of accuracy of the data students are using	
Published in	Sample	Label	Ratio of U-238 / Pb-206	Ratio of U-238 now / U-238 at formation	Age of rock	Label location of this sample shown on the map is accurate?	Ratio of these two elements is **exact or is simplified** based on other results
Yeshanew F, Pease V, Abdelsalam M, Whitehouse M. (2016) Table 1	n4737-02	G1	10.55	0.9134	583.8	no	exact
	n4737-12	G2	10.39	0.9122	592.3	no	exact
	n4737-14	G3	10.33	0.9117	595.7	no	exact
	n4737-28	G4	9.903	0.9083	659.1	no	exact

Related citations made in Stab, M., et al. (2015) *Modes of rifting in magma-rich settings: Tectono-magmatic evolution of Central Afar*. Tectonics.

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- Zumbo, V., G. Féraud, P. Vellutini, P. Piguet, and J. Vincent (1995), First 40Ar39Ar dating on early pliocene to plio-pleistocene magmatic events of the Afar—Republic of Djibouti, J. Volcanol. Geotherm. Res., 65(3), 281–295.