**S1. Error propagation method for heat flow calculations:**

Heat flow (*Q*) is the product of thermal conductivity (*K*), and the geothermal gradient (*G*),

For calculating the error in heat flow determination (Δ*Q*), we used the method of Chapra and Canale (2010):

Here, *K* and *G* are the measured values while Δ*K* andΔ*G* are their corresponding errors.

**S2. Heat productions of Central Anatolia granites:**

A substantial amount of compositional data is available from geochronology studies on granitic rocks of central Anatolia crystalline complex (CACC). These studies report U/Th/K concentrations which can be used for calculations of the radiogenic heat generation using the following formula (Ryback and Buntebarth, 1982):

Here, *A* is in (µW/m3), *ρ* is in (g/cm3), concentrations *cU*and *cT*h is in (ppm), and *cK* is in (%). Table S1 shows the calculated the heat generation from various sources (for *ρ*=2.7 g/cm3):

Table S1: U/Th/K concentrations from granitic samples in CCAC and calculated heat production values.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Locality** | **n** | **U(ppm)** | **Th(ppm)** | **K2O (wt%)** | **Reference** | **A (µW/m3)** |
| Satansari | 5 | 7.7 | 30.4 | 4.0 | Köksal et al. (2013) | **4.5** |
| Agacoren | 6 | 4.6 | 24.0 | 4.1 | Köksal et al. (2012) | **3.2** |
| Baranadag | 6 | 6.5 | 29.2 | 6.1 | Köksal et al. (2004) | **4.3** |
| Camsarı | 5 | 16.8 | 84.6 | 8.0 | Köksal et al. (2004) | **10.9** |
| Borucu | 1 | 6.3 | 25.0 | 4.0 | Köksal and Güncüoglu (2007) | **3.7** |
| Hisarkaya | 2 | 9.6 | 33.5 | 5.2 | Koeksal and Güncüoglu (2007) | **5.3** |
| Terlemez | 1 | 3.6 | 22.0 | 4.1 | Koeksal and Güncüoglu (2007) | **2.8** |
| Mankisla | 1 | 2.0 | 16.0 | 3.8 | Koeksal and Güncüoglu (2007) | **2.0** |
| Ekeceikdag | 41 | 7.2 | 22.2 | 4.9 | Tureli et al. (1993) | **3.8** |
| Behrekdag | 4 | 4.4 | 21.5 | 4.3 | İlbeyli et al. (2004) | **3.0** |
| Cefalikdag | 7 | 3.3 | 15.5 | 3.6 | İlbeyli et al. (2004) | **2.3** |
| Baranadag-2 | 7 | 7.1 | 35.9 | 5.7 | İlbeyli et al. (2004) | **4.8** |
| Hamit | 12 | 17.5 | 76.8 | 8.0 | İlbeyli et al. (2004) | **10.6** |
| Uckapili | 4 | 6.0 | 21.5 | 4.4 | Güncüoglu (1986) | **3.4** |

We observed a range of heat production values of 2-11 µW/m3, with an average value of 4.6 µW/m3.

**S3. One-dimensional conductive thermal modeling:**

We constructed the 1-D thermal model based on the surface heat flow (Q0) and heat generation (A0) data. We discretized the entire depth of the crust (Δz=0.1 km depth interval), and use the following formula (modified from Blackwell, 1971):

Here, Ai and λi represent the heat generation and thermal conductivity of i-th layer; Ti and Qi represent the temperature and the heat flow at the top of the i-th layer, and Ti+1 and Qi+1 represent the temperature and the heat flow at the bottom of the i-th layer. Starting from an initial (Q0 and To), one can calculate the temperature with depth.

We used a temperature dependent thermal conductivity model for the upper crustal rocks (modified from Eppelbaum, 2007):

where *T* is °C. We used a constant thermal conductivity of 2.1 Wm-1K-1 for the lower crust.

The reference crustal model physical parameters are as follows:

|  |  |  |
| --- | --- | --- |
|  | *λ* | *A*  |
| Upper crust (0-15 km) | λ0=3.0 and decreases with depth | 2.0 (0-10 km)0.25 (10-15 km) |
| Lower crust (15-35 km | 2.1 | 0.25 |

For granitic intrusions models, we replaced the first 5-10 km of the crust with a high heat production material while keeping all other parameters the same. For all models, a constant mantle heat flow of 38 mW/m2 was constrained.

References:

Chapra, S.C., Canale. R.P., 2010. *Numerical Methods for Engineers*, 6th Ed, Mc Graw-Hill.

Eppelbaum L., Kutasov, I., Pilchin A., 2014. *Applied Geothermics, Lecture Notes in Earth System Sciences*, Springer-Verlag Berlin Heidelberg.

Göncüoğlu, M.C., 1986. Geochronological data from the southern part (Niğde area) of the Central Anatolian Massif.*Mineral Research and Exploration Institute of Turkey (MTA) Bulletin*, *105*(106), pp.83-96.

Ilbeyli, N., Pearce, J.A., Thirlwall, M.F. and Mitchell, J.G., 2004. Petrogenesis of collision-related plutonics in Central Anatolia, Turkey. *Lithos*, *72*(3-4), pp.163-182.

Köksal, S., Toksoy-Köksal, F., Göncüoğlu, M.C., Möller, A., Gerdes, A., Frei, D., 2013. Crustal source of the Late Cretaceous Satansarı monzonite stock (central Anatolia–Turkey) and its significance for the Alpine geodynamic evolution. *Journal of Geodynamics*, *65*, 82-93.

Köksal, S., Möller, A., Göncüoglu, M.C., Frei, D., Gerdes, A., 2012. Crustal homogenization revealed by U–Pb zircon ages and Hf isotope evidence from the Late Cretaceous granitoids of the Agaçören intrusive suite (Central Anatolia/Turkey). *Contributions to Mineralogy and Petrology*, *163*(4), 725-743.

Köksal, S., Romer, R.L., Göncüoglu, M.C., Toksoy-Köksal, F., 2004. Timing of post-collisional H-type to A-type granitic magmatism: U–Pb titanite ages from the Alpine central Anatolian granitoids (Turkey). *International Journal of Earth Sciences*, *93*(6), 974-989.

Köksal, S. and Göncüoğlu, M.C., 2008. Sr and Nd isotopic characteristics of some S-, I-and A-type granitoids from Central Anatolia. *Turkish Journal of Earth Sciences*,*17*(1), 111-127.

Türeli, K.T., Göncüoglu, M.C., Akiman, O., 1993. Ekecikdağ granitoyidinin petrolojisi ve kökeni (Orta Anadolu kristalen kütlesi batisi): MTA Dergisi, v. 115.