README to execute Direct$D^{U}D^{Th}$

Red bolded text refers to folders and files found in this package of code.
***Folders are given in "" ***
Blue bolded text refers to executable MATLAB code.

Execute examples in the paper by running any of the **Step_3** files found in the folders
e.g., **AAA_Step_3_IP_EPR**

To modify examples:

1. Choose desired melting model by folder name:
   "INN Figures 5&7"
   "IP Figures 4&6"
   (other melting models coming soon)

2. Input composition of *M1*, *M2*, and, if using, *M3* into a file helpfully named for its data
   For example: file **EPR** contains:

```
% M1 = EPR R54-2
M1_Th230 = 1.2345;
M1_Ra226 = 1.343;
M1_K2Oerupted = 0.36;
M1_Uerupted = 0.26;
M1_Therupted = 0.72;
% M2 = A2370-1
M2_K2Oerupted = .11;
M2_Ra226 = 2.21;
M2_Th230 = 1.159;
```

   Note that *M1* also requires U and Th concentration, which is needed for U plots (e.g., **B** panel in Figure_Th230-Ra226-U-K2O)

3. Set-up the file, e.g., **AAA_Step_3_IP_EPR**, that calculates D^{U} and D^{Th} and generates figures by specific values within following categories:
   a. Colors for plotting
   b. F_R, the retained melt fraction
   c. The stability-field-of-melting
   d. t_{form}
   e. Name of file with *M1*, *M2*, and if using, *M3* compositions (e.g., **EPR**)
4. Execute the file **AAA_Step_3_IP_EPR**
5. Results as shown in Table 1 are automatically copied to the clipboard. Paste them into the tab titled **Blank Table** in the spreadsheet **Blank Results Table** in the main folder **"GITHUB DirectDUDTh".** To recopy results to the clipboard execute **mat2clip(results2clip)** Headings are:

t_{form}	$^{230}Th^*$	$^{226}Ra^*$	F_R	$D^{Ra}{}_B$	$D^{K2O}{}_B$	K_2O^{pri}	K_2O^s	F_N	F_P	$D^U{}_B$	$D^{Th}{}_B$	$(D^U/D^{Th})_B$	Tc
as.	*as.*	*as.*	*as.*	*as.*	*as.*	*as.*	*calc*	*calc*	*calc*	*calc*	*calc*	*calc*	*calc*

6. Save the figures as .eps files by executing **savefigs('_appendedFigTitle','nameFolder')**
   For example, **savefigs('_Append','Test')** saves the folder named *nameFolder* with the names
   - Figure_D versus F__appendedFigTitle

- Figure_Equiline__appendedFigTitle
- Figure_Th230-Ra226-U-K2O__appendedFigTitle
- Figure_ThU230Th v ThU__appendedFigTitle

To import new compositional data for plotting in **Step_3**, execute **Step_1** and then **Step_2** in folder "**Import Data Figure 1"**. I am working on writing better instructions. In the meantime, please feel free to contact me to walk you through it.

Step1_importNewData reads data from a spreadsheet, e.g., **earthchem_download_22873_ALL_UTH_Diseq.xlsx** and saves it with the filename you prescribe, e.g., **AllUTh**.

> You do not need to reorder the columns — you only need to denote which columns contain major element data and which columns contain trace or isotope data as shown in **earthchem_download_22873_ALL_UTH_Diseq.xlsx**.

Step_2_plot_paperfigures_includesFig1 plots the imported data. It currently generates 39 figures that can all be modified. Again, contact me if you need help.

Right now you must manually edit the data plotted in **Step_3** by searching for the lines `% Real Data for Comparison` and editing the following code accordingly.