Radio and Chemo Toxicity from Exposure to Uranium and related metals: A case study of Mrima Hill

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Outline of Discussion

- Introduction
- Justification of study
- Methodology
- Results and discussion
- Conclusion and recommendation

Introduction

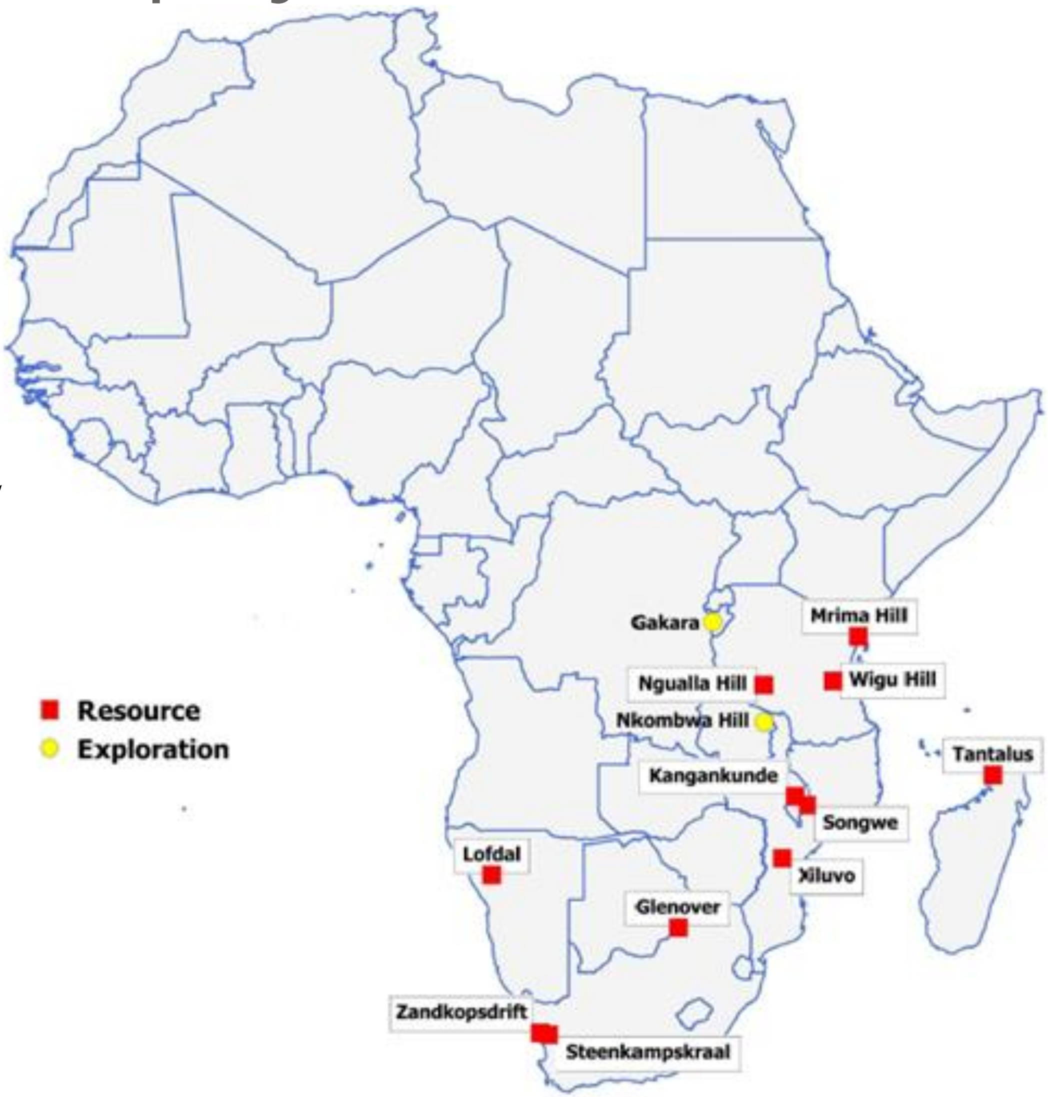
- REE, Nb and other like metals play a critical role in modern high electronic devices
- China Produces 95% of the REE and consumes 75% of the global production.

Global REE sources

Deposit	Country	Size, t REO	Grade	Deposit type
Bayan Obo	China	48,000,000	6	Iron-Rich
Araxa	Brazil	8,100,000	1.8	Carbonatite Laterite
Mountain Pass	United States	1,800,000	8.9	Carbonatite
Mount Weld	Australia	1700,000	11.2	Carbonatite Laterite
Dubbo	Australia	700,000	0.86	Trachyte
Mrima Hill	**Kenya**	**300,000**	**5**	**Carbonatite Laterite**
Nalan's Base	Australia	150,000	4	Vein
Xunwu and Longman	China	Unknown	0.05-0.2	Laterite
Wishan	China	Unknown	1.6	Vein

Castor and Hedrick (2011)

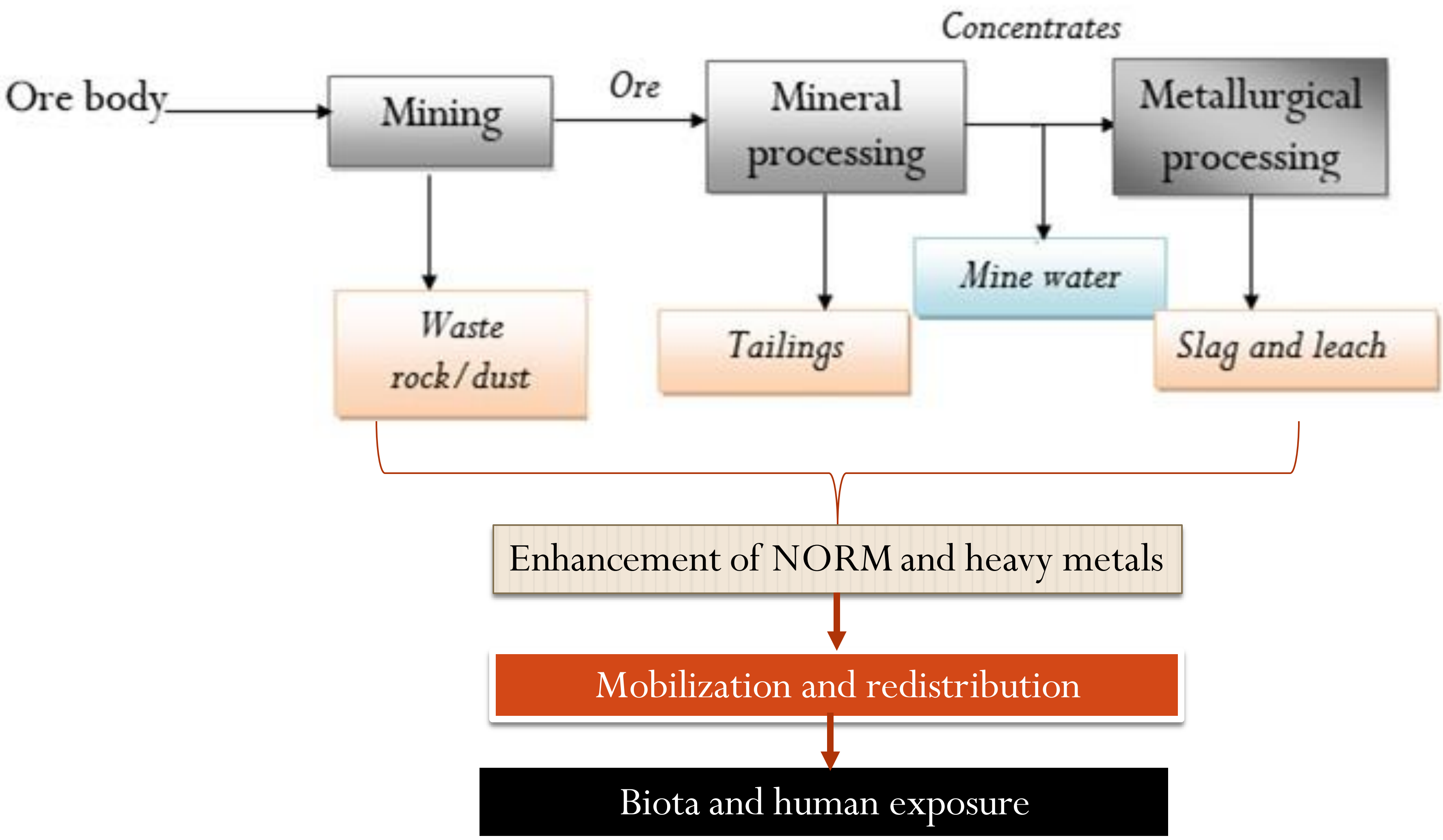
REEE projects in Africa



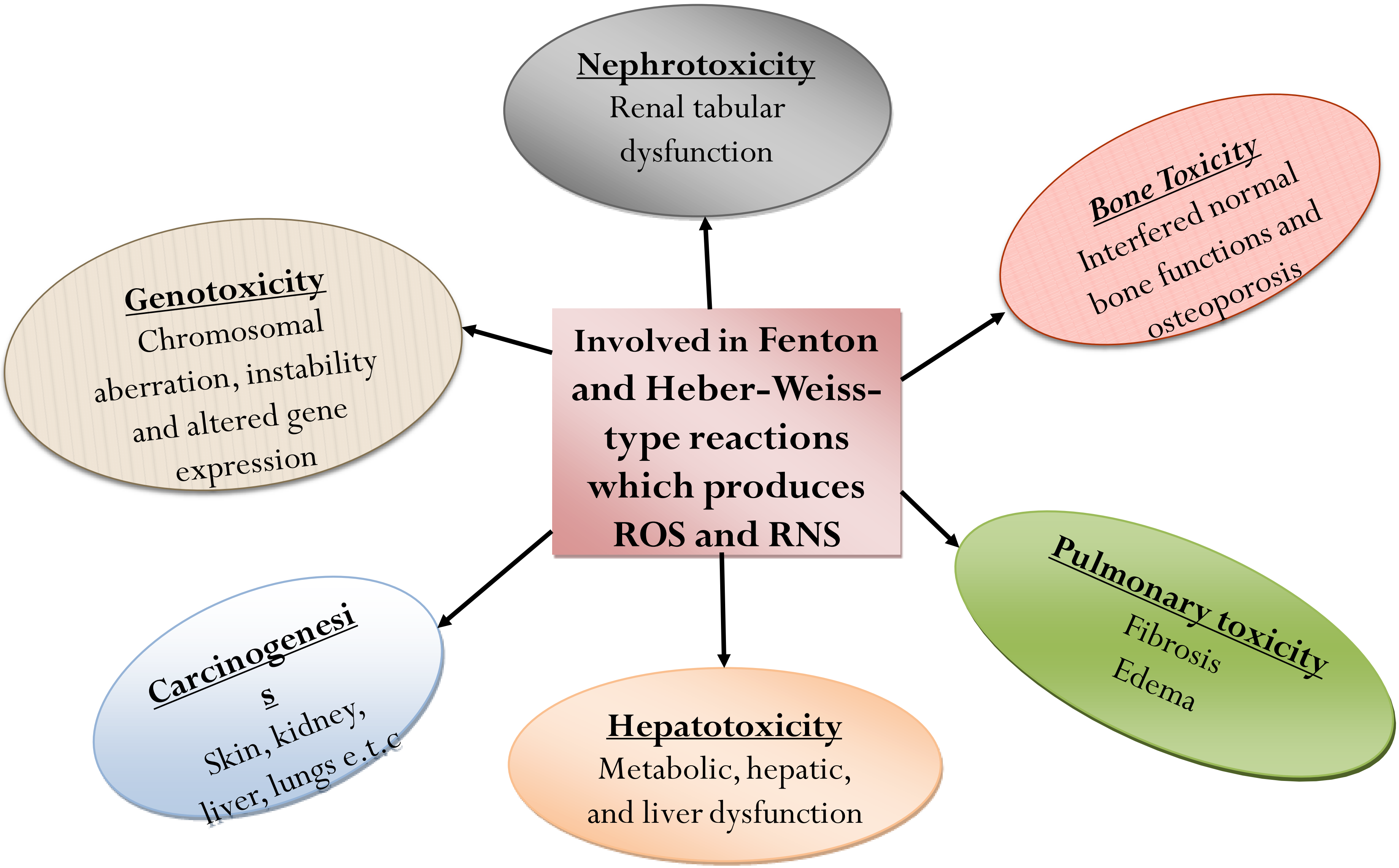
Africa is the next frontier of REE production

Herman and Rex (2016)

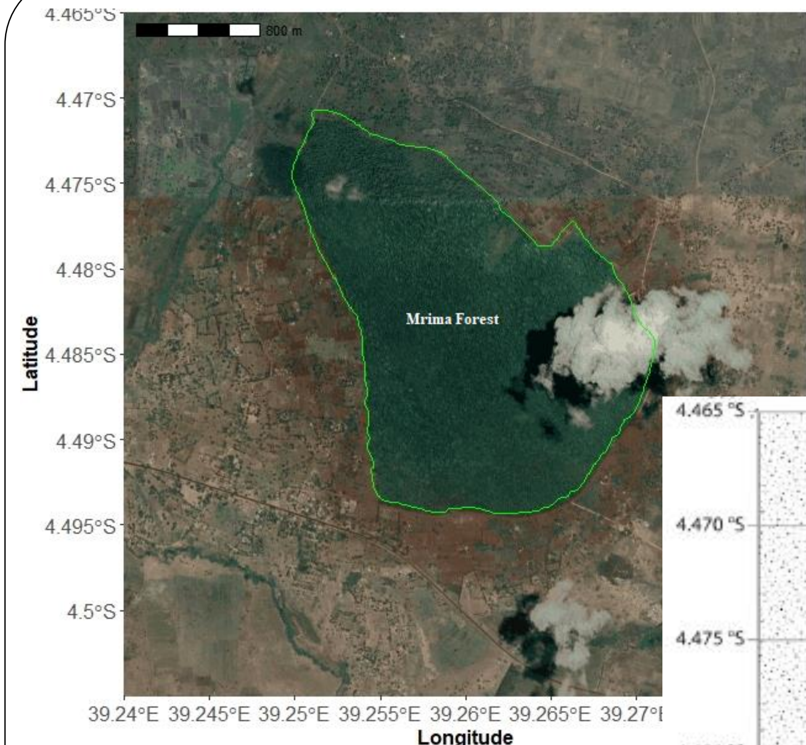
Justification of study



Human health risk

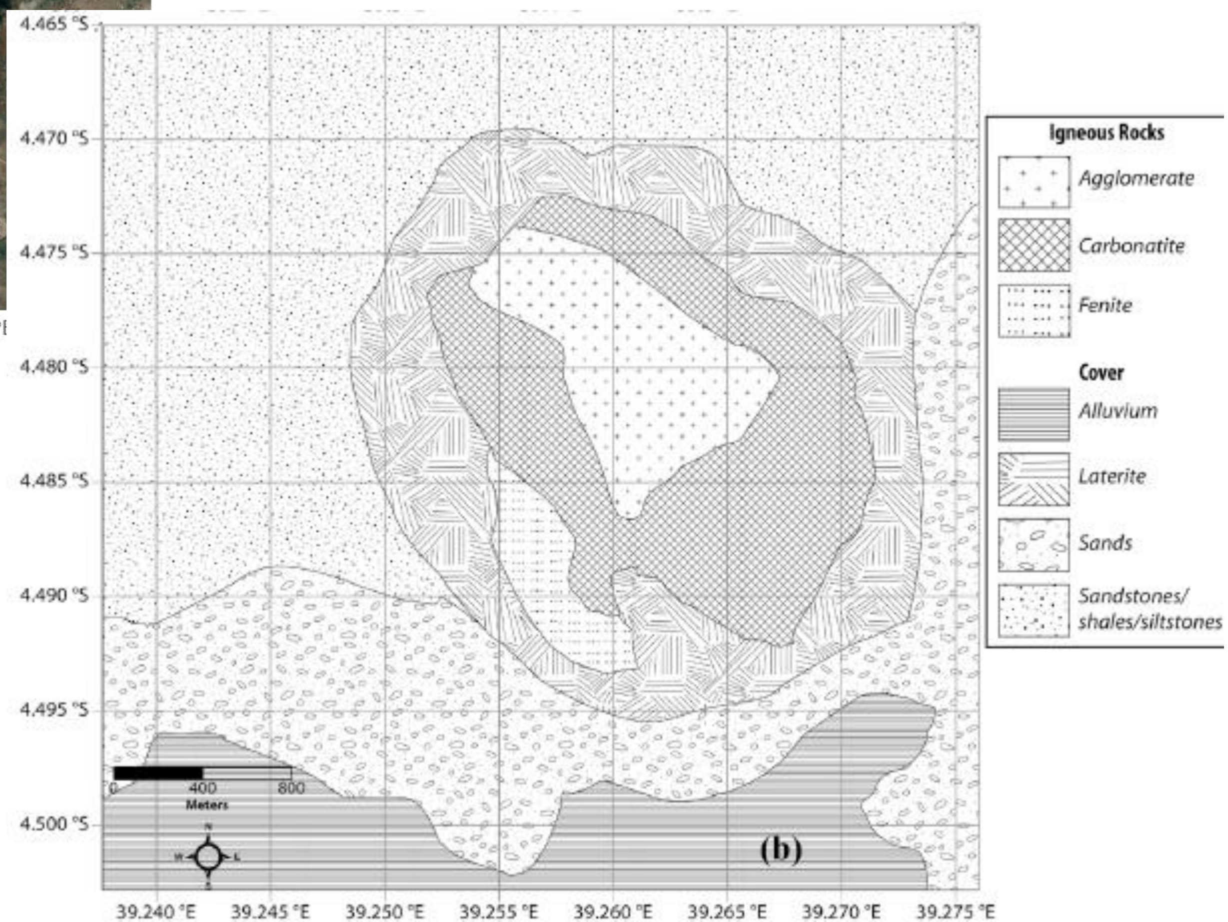


Study area



Topology of Mrima

Geology of Mrima



Alkaline-Carbonatite intrusion rich in REE, Nb, Zr, Ta, Th and U

Kaniu *et al.* (2019)

Methodology

a) Sample preparation and analysis

Drying

Crushing

Sieving

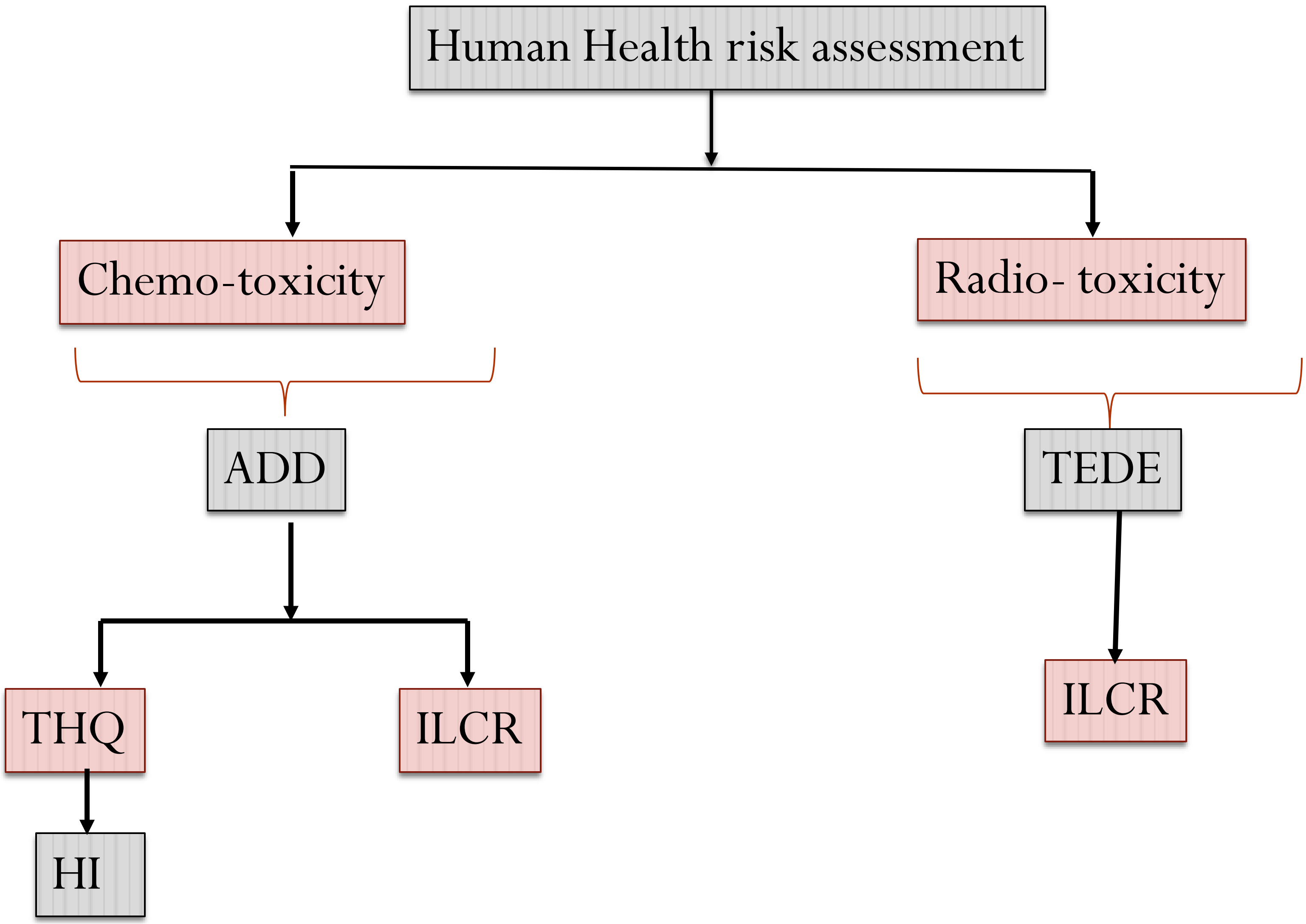
Wet digestion

Filtering

Dilution

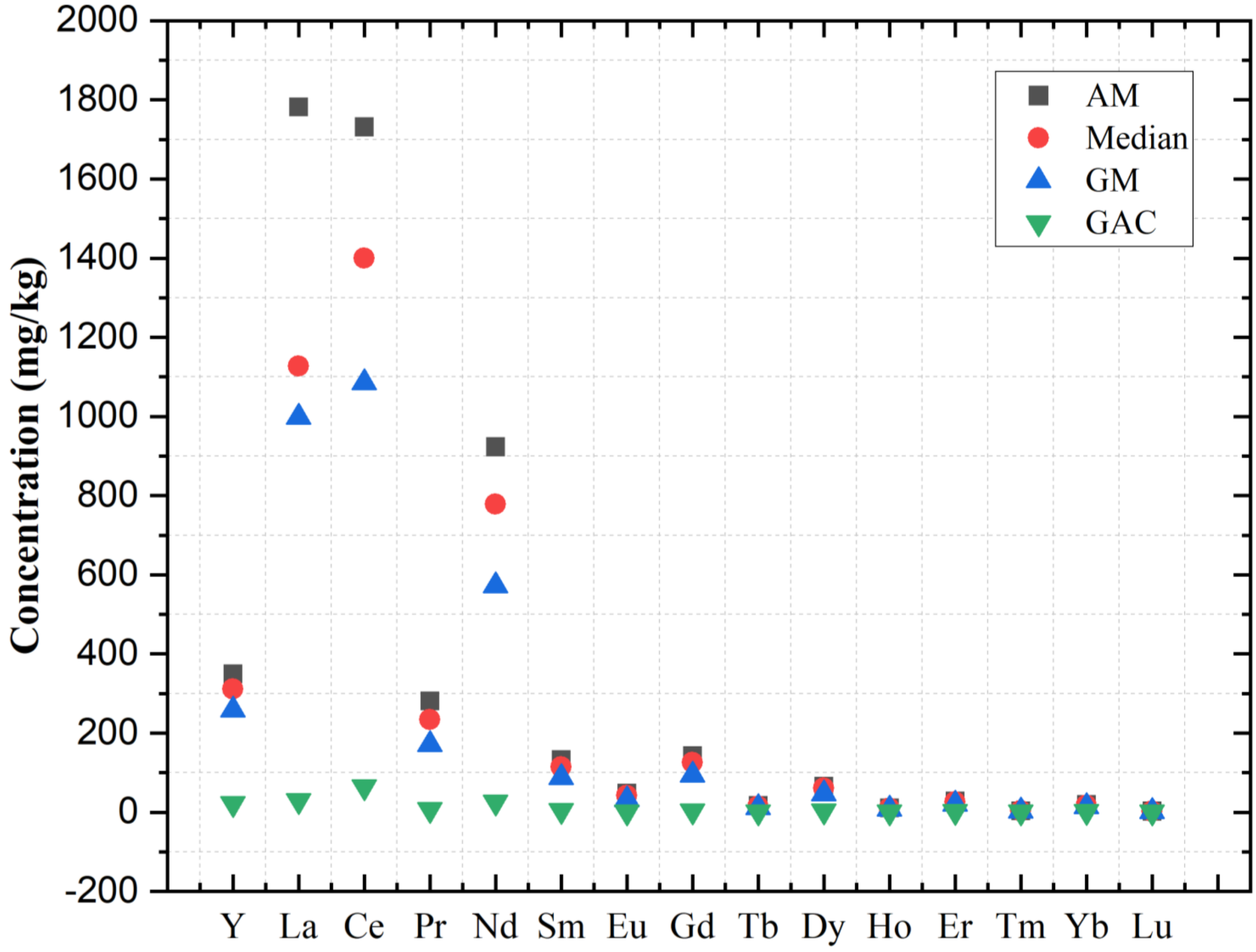
ICP-MS analysis

Methodology

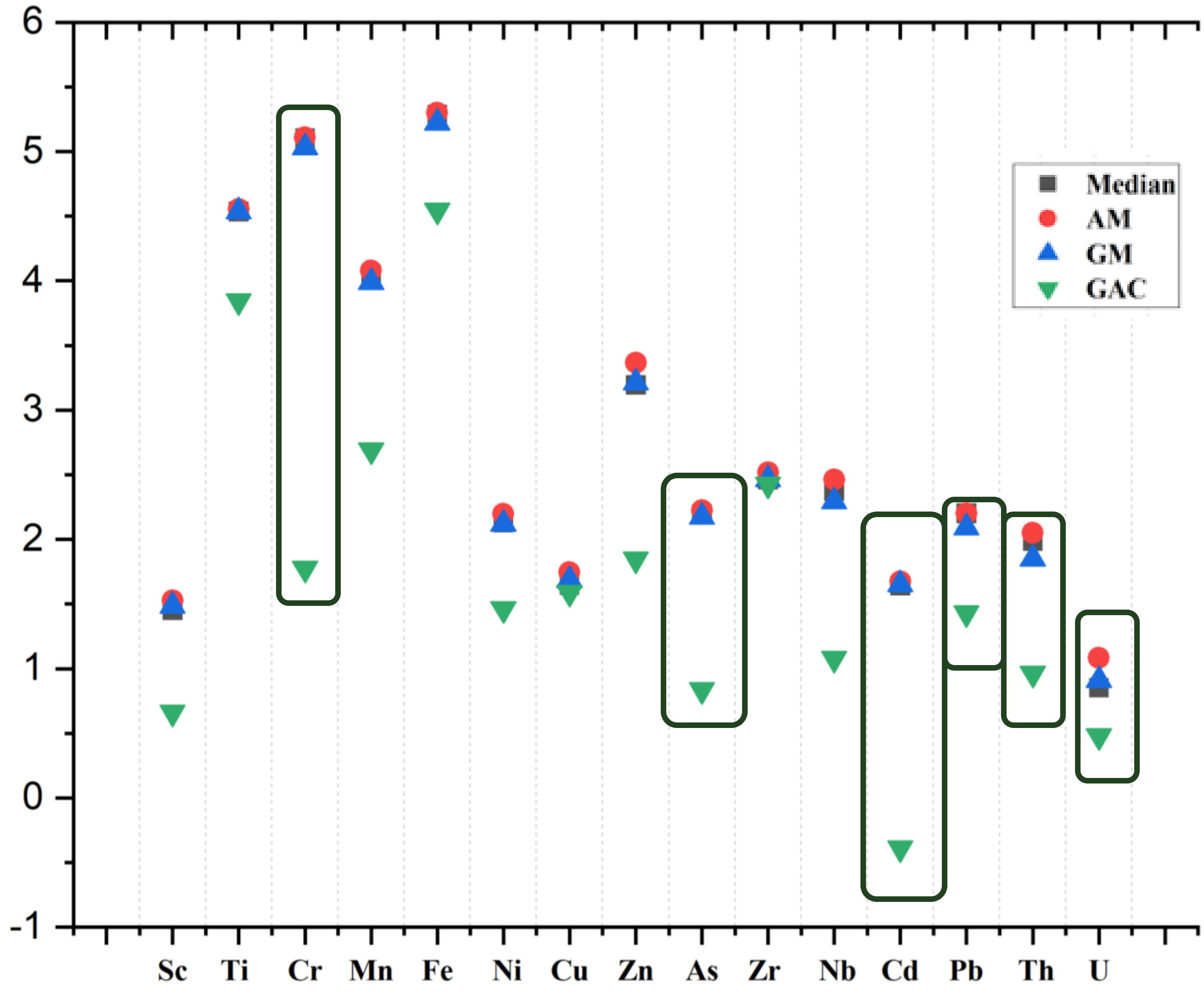


Distribution of REE, U and related heavy metals in soil samples

i. Statistical summaries of REE in topsoils from environs of Mrima Hill in comparison to upper crust abundance, (Global Average Concentration, GAC)

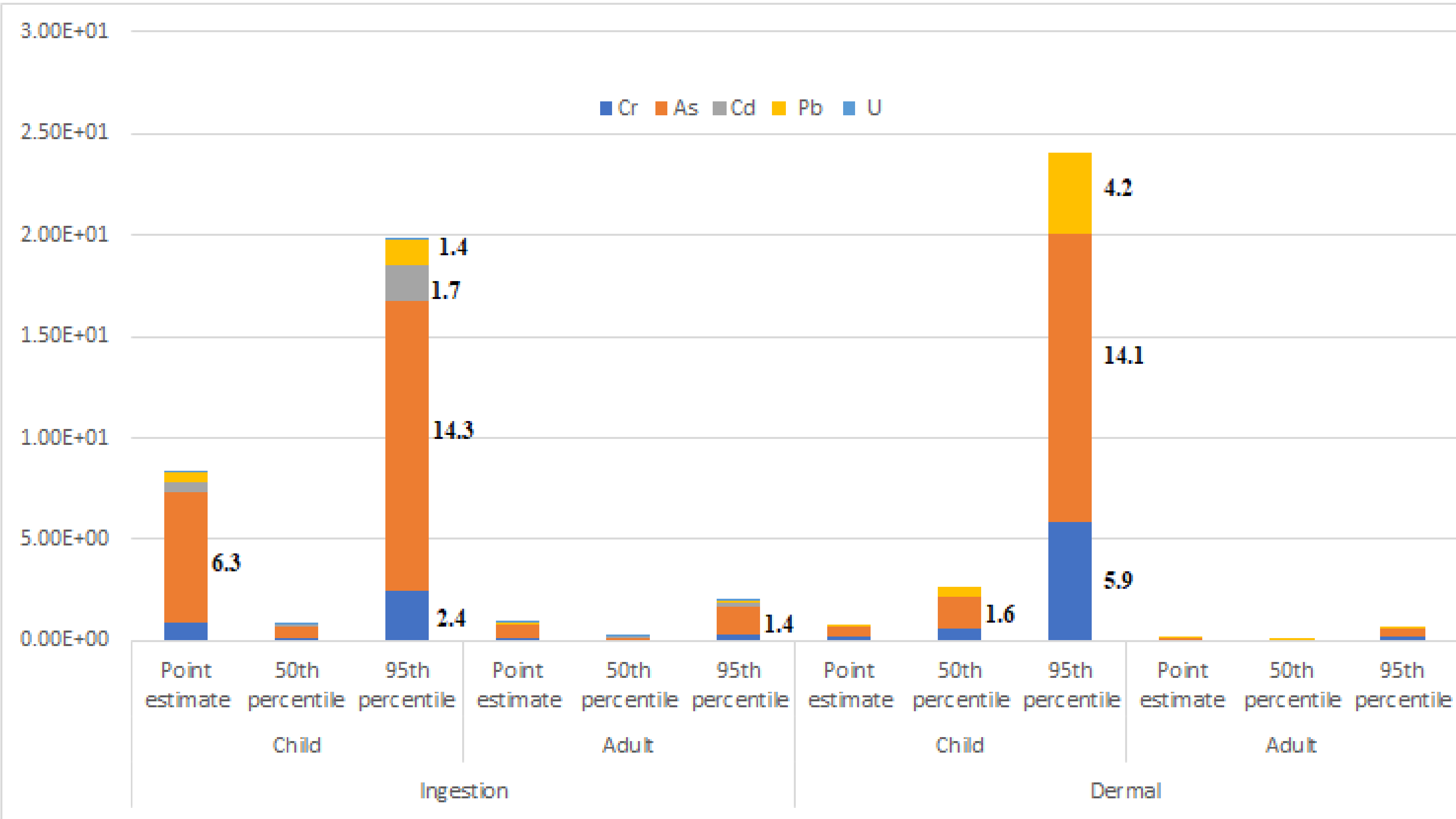


ii. Statistical summaries of U and related heavy metals in soil samples with a comparison to global average concentration of metals in topsoils



Health Risk assessment

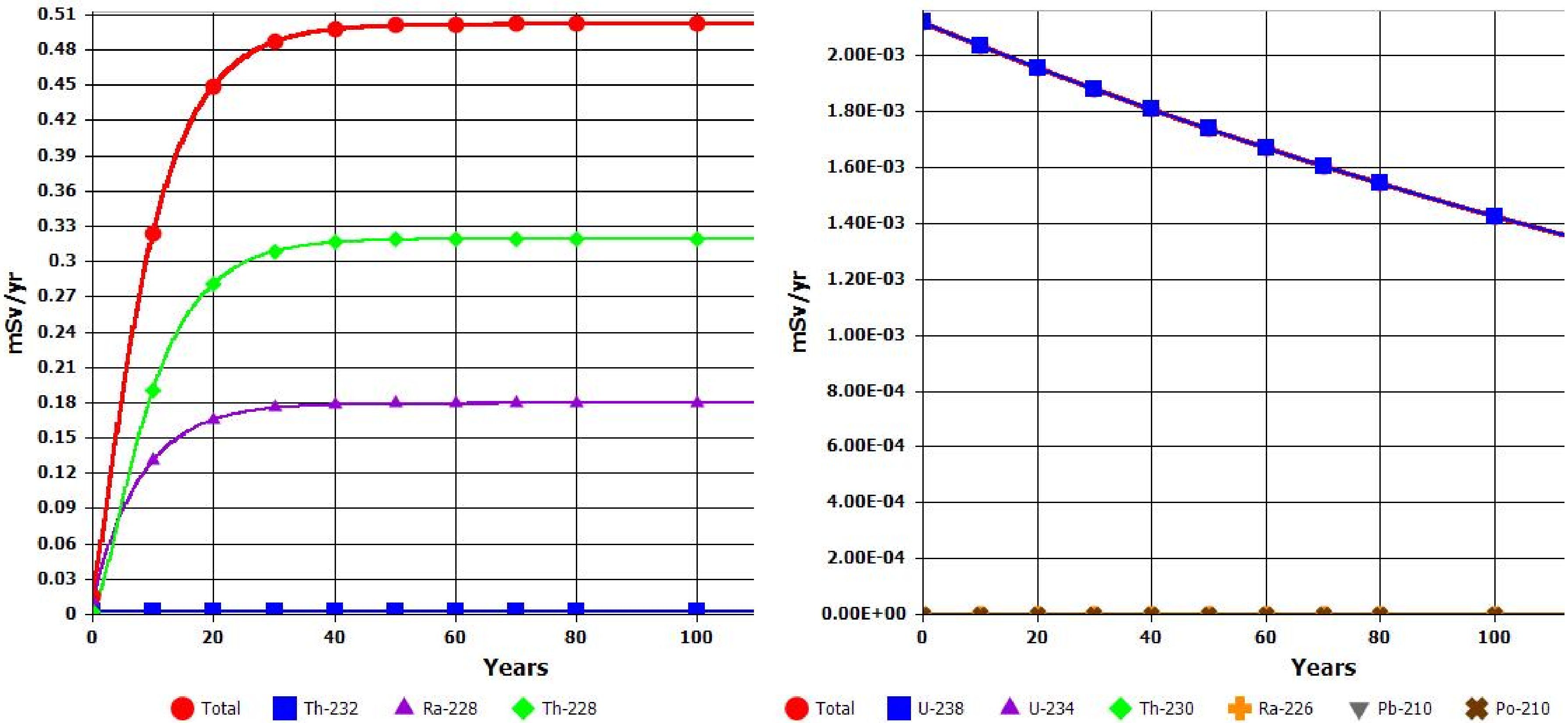
a) Chemo-toxicity: Non-Carcinogenic health risk



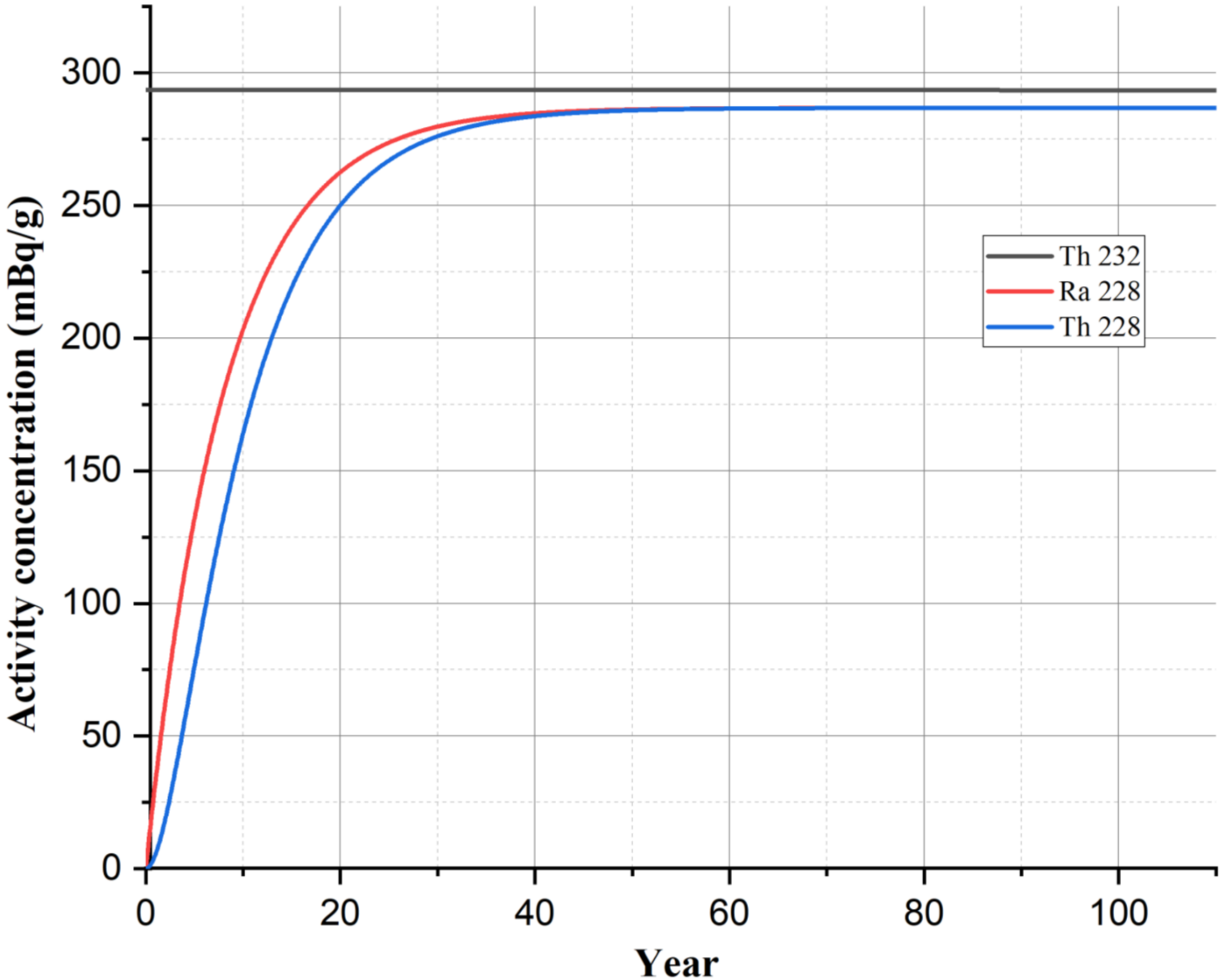
Chemo-toxicity: Carcinogenic health risk assessment

- Incremental lifetime cancer risk from ingestion of As, Cr, and Pb in soil
  - $\mathrm{ILCR_{Cr}} > 10^{-4}$; $\mathrm{ILCR_{As}}$ was within permissible limits and $\mathrm{ILCR_{Pb}}$ was below the permissible limits
- Incremental cancer lifetime risk from ingestion of As, Cr, and Pb in drinking water
  - $\mathrm{ILCR_{Cr}}$ *and* $\mathrm{ILCR}_{As} > 10^{-4}$; and ILCR_{Pb} *was within* the permissible limits
- Incremental cancer lifetime risk from dermal exposure to As in soil
  - $ILCR_{deterministic,\ child} > 10^{-4}$; $ILCR_{probabilisitic,\ child}$ *and* $ILCR_{adult}$ *were within permissible limits*
- $\sum ILCR > 10^{-4}$, thus, the population was susceptible to carcinogenic effects from exposure to As, Pb and Cr

a) Radio-toxicity- Total Effective Dose Equivalent (TEDE)



Contribution of the parent nuclides, ^{232}Th and ^{238}U, and their progenies in soil samples to TEDE (mSv/year)



Ingrowth of ^{232}Th progenies in soil samples

Radio-toxicity: Incremental lifetime cancer risk (ILCR)

- The total ILCR from exposure to the ^{232}Th, ^{238}U, and progenies was above the regulatory limit of 10^{-4}
- 90% of the total ILCR was from exposure external exposure to ^{228}Ra and ^{228}Th.
- ILCR from ingestion of soil and inhalation of dust particles was below 10^{-4}.
- $ILCR_{External} > ILCR_{ingestion} > ILCR_{inhalation}$

Conclusion and recommendation

Conclusion

- REE, Nb and other metal concentration was higher than the earth upper crust abundance
- Carcinogenic and non-carcinogenic assessment showed that the populace is prone to both non-carcinogenic and carcinogenic health risk from exposure to heavy metals.

Recommendation

- There is a need to put in place mechanisms to monitor, control and mitigate environmental pollution
- Epidemiological studies from exposure to heavy metals need to be done to assess the occurrence and distribution of health risk from exposure to heavy metals
- Methods to reduce As, Cd and Cr contamination of environmental media could be employed to mitigate on the risks from exposure to metals

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