

## Reduction of Radioactivity in $^{232}\text{Th}$ via Induced Cluster Decay?

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A novel and proprietary process – Co-Created and Co-Owned by TED and ZDN – has been privately demonstrated to rapidly reduce radioactivity. Instrumented replication – of earlier exploratory thermal reaction study – resulted in an ~51% ( $\pm 2.5\%$ ) reduction of in  $^{232}\text{Th}$ . Accompanying this was finding added Mg with both non-terrestrial ratios of: (1)  $^{25}\text{Mg}$  to  $^{24}\text{Mg}$  of 1.03:1 (vs. terrestrial ~1:7.5,  $p = 0.0002$ ); and (2)  $^{26}\text{Mg}$  to  $^{25}\text{Mg}$  of 0:1 (vs. terrestrial ~1:1,  $p = 0.0001$ ). Profoundly unanticipated under the experimental thermal conditions (by orders of magnitude), these findings appear consistent with a cluster-decay/fission of  $^{232}\text{Th}$  by emission of  $^{24-25}\text{Ne}$  and  $^{206-207}\text{Hg}$  particles (via herein outlined pathways). Supporting this was: ~1:1 balance between the ~51% loss in  $^{232}\text{Th}$  mass and the cluster-fission consistent  $^{24}\text{Mg}$  &  $^{25}\text{Mg}$  masses (via respectively  $^{206}\text{Hg}$  and  $^{207}\text{Hg}$ ). This instrumented replication consequently is strongly suggestive of cluster-fission – with a rapid 51% reduction of  $^{232}\text{Th}$  ( $\leq 19$  Days). We recommend independent research assessing the validity of this apparent relatively low-temperature cluster-fission of  $^{232}\text{Th}$ .

### INTRODUCTION

An instrumented-replication was conducted toward understanding the nature of previously observed rapid (Minutes) and profound ( $>20X$ ) reductions in apparent radioactive emissions of post thermally-treated  $^{232}\text{Th}$  (~14 Billion-Year Half-Life). Previous  $^{232}\text{Th}$  studies had revealed a pattern of an initial substantial reduction within an hour post a modest (3660K) thermal process (YS & TED). This was then followed by shallow continuing declines toward an effectively background value during the following weeks. Of particular note, these  $^{232}\text{Th}$  series studies had been undertaken given its remarkable long half-life vs those of a variety of other radioactive radionuclides that earlier had evidenced similar “radiation reductions” (TED & ZDN). Our purpose here was to initiate formal investigations of possible radiation-reduction mechanisms following thermal treatment of  $^{232}\text{Th}$ .

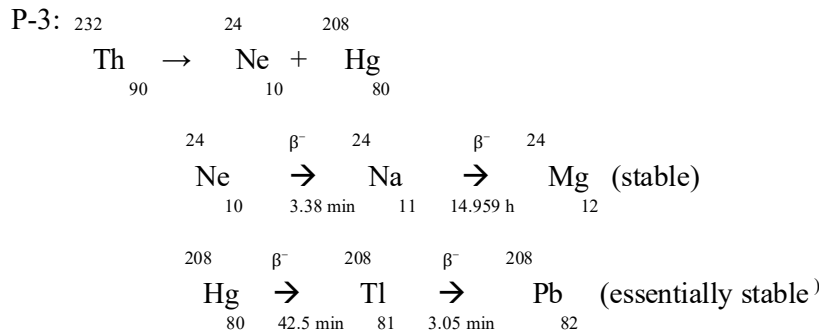
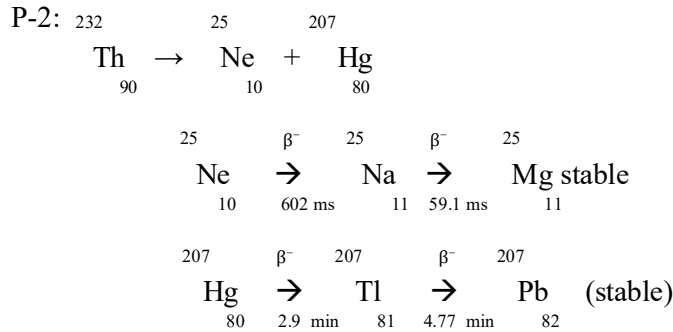
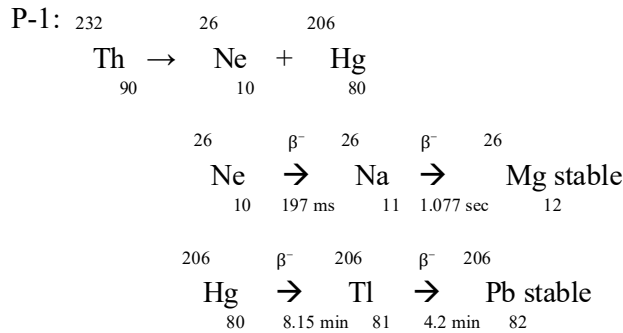
### BACKGROUND

Standard nuclear decay processes (esp.  $^{232}\text{Th}$ ) initially appeared profoundly inconsistent with our previous and current results. However, “*cluster decay*”—heavy nuclei decay via an intermediate process between alpha decay and spontaneous fission – appeared to offer a not implausible theoretical mechanism (Sandulescu, Poenaru & Greiner, 1980). In this regard, Sandulescu et al.’s speculated process was initially confirmed by the observation of heavy-ion 30-MeV, carbon-14 emission from radium-223 (Rose & Jones, 1984). More pertinently, regarding  $^{232}\text{Th}$ , Poenaru, et al. (1989) calculated a possible  $^{232}\text{Th} \rightarrow ^{26}\text{Ne} + ^{206}\text{Hg}$  cluster fission model<sup>3</sup> and subsequently Bonetti, et al. (1995) first reported observation of a spontaneous cluster decay of  $^{232}\text{Th}$ . Subsequently, du Toit, Wyngaardt and Perez (2014) delineated explorations of the

cluster emission of Ne isotopes from the nuclei  $^{232}\text{Th}$  and  $^{234}\text{U}$ . Of note, however, du Toit et al. were unable to distinguish between the isotopes  $^{24}\text{Ne}$  and  $^{26}\text{Ne}$ . In this regard, as will be seen shortly, we delineate pathways for both of these (P-1 and P-3) as well as a novel  $^{25}\text{Ne}$  decay avenue (P-2) which we have found hold particular promise for our findings. We note – before delineation of perspective cluster decay routes – a recent review that outlines some of the above history as well as provides salient understandings of ongoing research (Jain et al., 2023).

### CLUSTER DECAY ROUTES

The following outlines three plausible  $^{232}\text{Th}$  cluster decay pathways (P-1 to P-3) – with transitional half-lives – that are consistent with previous research. These, it should be noted, are not exhaustive; indeed, there are other plausible cluster decay pathways, e.g.,  $^{232}\text{Th} \rightarrow ^{22}\text{O} + ^{210}\text{Pb}$  (e.g., Santhosh, Priyanka & Unnikrishnan, 2014). As also reflected by Santhosh et al., two of these – (P-1) and P-3) – have been particular objects of study, but not the intermediate pathway to  $^{25}\text{Mg}$ . (P-2). This latter  $^{25}\text{Mg}$  pathway – as that for  $^{24}\text{Mg}$  (P-1) – will become especially relevant later with regard to our later presented spectrographic results.



## METHOD

Thorium dioxide (10g) and an amount of this proprietary pyro-flux mixture – including a Pb component – were placed in the reaction chamber with air-filter and ignited. The resulting pyro-metallurgical process temperature exceeded 3,390°C (6134°F), the melting point of thorium oxide. Beta and gamma radiation were assessed before ignition, and both 30 minutes and 19 days after reaction initiation (*Ranger EXP Meter, E.I. International, Inc, undated*). Mass spectrometric analyses were subsequently performed at the University of Washington using their *Nu Instruments: Inductively-Coupled-Plasma Mass Spectrometer* (Nelson, 2020). A variety of other non-listed instrumentation was also employed, but their results proved essentially unrelated to interpretations of the radiation and spectrometric findings.

## RESULTS AND DISCUSSION

Radiation and spectrographic results are sequentially delineated and discussed in the body of this section. Implications for future research are delineated in the concluding section.

### RADIATION

Table 1 summarizes the Beta and Gamma radiation levels over the course of the experiment. Examining this table, a broad – statistically significant pattern – is evident across the four assessments ( $F(3,3) = 52.26, p < .005$ ).<sup>1</sup> Specifically, on Day 1 (pretreatment), Source Material Beta and Gamma levels were respectively: 1) ~500- and 444-fold over Background; 2) these ratios had fallen ~20 and ~4 fold within 30 minutes post-treatment on the same day, and 3) respective Beta (CPM) and Gamma levels ( $\mu\text{R/hr}$ ) had returned to essentially Background by Day 19 ( $t(3) = 0.71$ , NS for Ln-transformed data).

Table 1 Radiation Assessments Across Experimental Periods

| TYPE  | BACKGROUND          | SOURCE MATERIAL<br>( <sup>232</sup> Th) | 30<br>MINUTES        | 19<br>DAYS          |
|-------|---------------------|-----------------------------------------|----------------------|---------------------|
| BETA  | ~30 CPM             | ~15000 CPM                              | ~600 CPM             | ~25 CPM             |
| GAMMA | ~9 $\mu\text{R/hr}$ | ~4000 $\mu\text{R/hr}$                  | ~33 $\mu\text{R/hr}$ | ~7 $\mu\text{R/hr}$ |

### SPECTROGRAPHIC RESULTS

Tables 2 and 3 respectively outline salient spectrographic results and typical terrestrial proportions of Mg and <sup>235</sup>U/<sup>238</sup>U isotopes.<sup>2</sup> Examining Table 2, one may first note that substantial portions of initial <sup>232</sup>Th (~half) are still present in the residual “white metallic disk” (D01) and a “black powder (S01) post reaction products – with a ~51% ( $\pm 2.5\%$ ) reduction weighted by relative sample masses). This result ordinarily would have suggested – in contrast to the above reported observations -- that beta and gamma radiation levels might have been near half those of the source material pre-treatment at Day 19 (vs. effectively

<sup>1</sup> ANOVA was here performed on Ln-transformed values using the mean score interaction as error (Q-Q Plot – though limited in power – supported uses of Ln-transformation and use of the interaction term as “error.” Later analyses employed “essentially orthogonal” *t*-comparisons of observed vs. terrestrially expected proportions. Bittner (2022) recently overviewed the robustness of ANOVA (and relatedly *t*-tests as  $F(1, dF) = t^2(dF)$ ).

<sup>2</sup>We chose – though observed <sup>235</sup>U/<sup>238</sup>U ratio is significantly different from ordinarily terrestrial -- to not highlight this as anomalous ratios occasionally occur in trace samples (e.g., Sakuragi, Meason, & Kuroda, 1983).

background). However, a consultant's report of a previous parallel Pb associated anomalies, strongly suggested this was largely due to a combination of surface coating and interior shielding by Pb (introduced with flux material).<sup>3</sup>

Further examining Table 2, it is noteworthy that substantial levels of Mg are in the residual “white metallic disk” (D01) and a “black powder (S01) post reaction products. This is remarkably intriguing as Mg was essentially *not-present* prior to the pyro-treatment (i.e., *not in* <sup>232</sup>Th sample, pyro, and/or other materials). Equally intriguing, one also may note – in contrast with terrestrial isotope proportions (Table 2) – both: 1) somewhat more than equal relative proportions <sup>25</sup>Mg to <sup>24</sup>Mg in both the “white metallic disk” (D01) and 2) a “black powder (S01) residual products (1.02:1 and 1.03:1) and 2) no reported detection of <sup>26</sup>Mg in either D01 or S01. These latter results altogether profoundly contrast against the terrestrial range of; 77%-79% <sup>24</sup>Mg vs. 10%-11% <sup>25</sup>Mg ( $t(1) = -3599.29, p < .0002$ ); and 10-11% <sup>25</sup>Mg vs. 11% <sup>26</sup>Mg ( $t(1) = 6586.79, p < .0001$ ). .

**Table 2. Mass Spectrometric Results (ppm)**

| SAMPLE | <sup>232</sup> Th<br>(ppm) | <sup>24</sup> Mg<br>(ppm) | <sup>25</sup> Mg<br>(ppm) | <sup>26</sup> Mg<br>(ppm) | <sup>235</sup> U<br>(ppm) | <sup>238</sup> U<br>(ppm) |
|--------|----------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|
| D01    | 5829                       | 1574                      | 1619                      | ND                        | 1.4                       | 1.4                       |
| S01    | 6498                       | 4718                      | 4855                      | ND                        | 1.8                       | 1.7                       |

**Table 3. Terrestrial Isotope Relative Natural Abundances (%)**

| NATURAL<br>ABUNDANCE | <sup>232</sup> Th<br>(%) | <sup>24</sup> Mg<br>(%) | <sup>25</sup> Mg<br>(%) | <sup>26</sup> Mg<br>(%) | <sup>235</sup> U<br>(%) | <sup>238</sup> U<br>(%) |
|----------------------|--------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
|                      | 100%                     | 77%-79%                 | 10%-11%                 | 11%                     | 0.72%                   | 99.3%                   |

Beyond the remarkable contrast between typical natural terrestrial and the unexpectedly observed Mg isotopes, was the intriguing ratio of Mg to <sup>232</sup>Th in the samples. Specifically, the ratios of total found <sup>24+25</sup>Mg to residual <sup>232</sup>Th (ppm) was (1) ~1.02 both within and across D01 and S01, and 2) this is remarkably near the ratio of 1.04 that might be anticipated with a 51% conversion of <sup>232</sup>Th to <sup>24+25</sup>Mg. This – and the profound mismatch between observed and natural <sup>24-25</sup>Mg isotopes -- would appear to point toward near equal frequency of cluster decay routes P-2 and P-3 (albeit P-2 apparently slightly favored over P-3).

## CONCLUSION

Results of our replication are essentially consistent with a novel process for reducing <sup>232</sup>Th – via cluster-decay emission of <sup>24-26</sup>Ne and <sup>206-208</sup>Hg – to non-radioactive isotopically-stable elements (esp. <sup>24</sup>Mg and <sup>25</sup>Mg). Reflecting – in addition to an ~ 51% reduction in <sup>232</sup>Th mass – spectrographic analysis revealed 1) an ~1:1 ratio between the ~1/2 residual <sup>232</sup>Th and posited total <sup>24</sup>Mg+<sup>25</sup>Mg (via. <sup>206-208</sup>Hg), and 2) a near theoretically anticipated ratio of <sup>25</sup>Mg to <sup>24</sup>Mg of 1.03:1 (vs. terrestrial ~0.13:1). This proprietary process consequently may have unexpectedly achieved ~51% reduction of <sup>232</sup>Th in 19 days vs. the nominal <sup>232</sup>Th half-life of 14 billion years – a finding that strongly begs for near-term independent replication.

<sup>3</sup>Pb flux shielding – itself -- may have considerable utility in other contexts (e.g., nuclear waste management).

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