

Idaho Incubation Fund Program

Progress Report Form

Proposal No. _____
Name: **Daniel S. Dale**
Name of Institution: **Idaho State University**
Project Title: **Commercialization of Trace Element Detection Technology**
Reporting Period: **12/31/2016 – 6/22/2017**

Information to be reported in your progress report is as follows (attach additional information as needed):

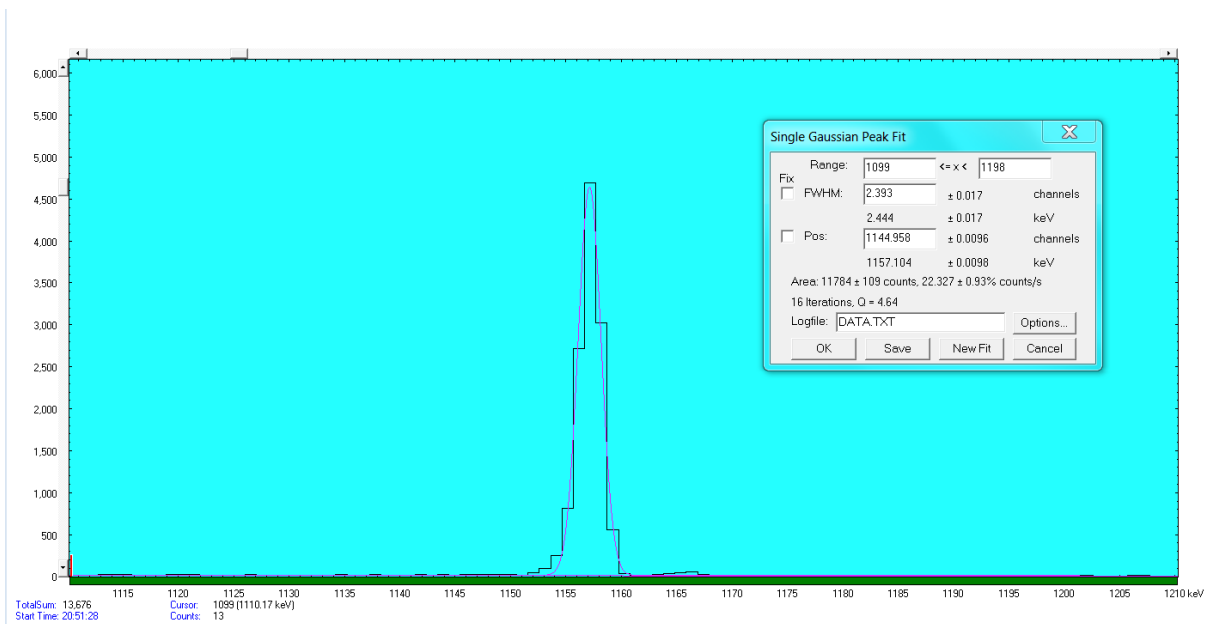
1. Summary of project accomplishments for the period just completed and plans for the coming reporting period:

(1) During this reporting period, we have continued progress in developing a database for use in identifying elements and nuclides with photon activation analysis. The database now contains 650 gamma ray lines. Elements entered include the following: Na, Mg, Al, Cl, Ar, K, Ca, Sc, Ti, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, Ge, As, Se, Br, Kr, Rb, Sr, Y, Nb, Rh, Pd, Ba, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Ir, Au, Tl, Pb, Bi

(2) We have also upgraded the web page which will advertise the technique to potential customers. It can be found at:

<http://www2.cose.isu.edu/~dale/research.html>

(3) In mid-February 2017, we irradiated samples of slag from the former FMC plant in Pocatello, ID, to ascertain the concentrations of rare earth elements. We also irradiated samples spiked with elements of interest (Eu, Ce, Pr, Y, and Sc) to enable quantitative extractions of the compositions of these elements. The purpose of this run was two-fold. First, to demonstrate the photon activation analysis technique in analyzing mining wastes. Second, to determine if any of these elements are present in commercially significant quantities. A sample of part of the spectrum arising from scandium is shown below:



- (4) Analysis of these data revealed 18.5 ppm by mass of Scandium in the sample.
- (5) In mid May we irradiated coal, coal ash, and fly ash from Rocky Mountain Power. As before, we also irradiated samples spiked with elements of interest to enable us to determine precise elemental compositions. Analysis of these data is underway. Results will be presented in the final report.
- (6) In late May 2017 we obtained data on lead samples for a number of bullets. While the initial hope was that we could use PAA to do lead isotope fingerprinting, it was determined that matrix effects were significant and elaborate sample preparation would be required. Nevertheless, the secondary goal, which was a success, was to determine differences in elemental composition of the bullets. Although the data are still under analysis, preliminary indications are that the technique can distinguish the various bullet types.
- (7) In the course of the above investigations, it was determined that photon activation analysis could potentially be used to develop a new method of well logging for petroleum extraction. Formation density logging typically used a Cesium-137 source which has environmental safety issues, and it could potentially be diverted to make a dirty bomb. We are investigating an alternative radioactive source, Y-88 which is potentially less problematic due to its shorter (107 days) half life as compares to Cs-137 (30 years). As such, we have used photon activation to produce a sample of Y-88, and are currently preparing experiments to test its utility in well logging. This will be a project of Emily Olphant, an ISU undergraduate physics major.

2. Summary of budget expenditures for the period just completed (**include project burn rate**):

All funds have been spent.

3. Numbers of faculty and student participation resulting from the funding, including internships:

M.S. student: Nate Gardner

Faculty: Dan Dale, Tony Forest, Frank Harmon

Scientific staff: Jon Stoner

Undergraduate student: Emily Oliphant

4. List patents, copyrights, plant variety protection received or pending:

None.

5. List technology licenses signed and start-up businesses created:

None.

6. Status of private/industry partnerships (include enough information to judge level of engagement):

A new collaboration has been struck up with Niowave, Inc. in Michigan in conjunction with the well logging work. Niowave makes high power accelerators.

7. Any other pertinent information that will indicate to the council that the project is meeting satisfactory progress.

Training of physics undergraduate student Emily Oliphant is underway. Continued training of M.S. student, Nate Gardner, on the photon activation analysis technique is well underway. A large amount of data has been taken. Analysis is underway.