Standard Operating Procedure

XRF

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| **Department:** | Earth and Environmental Sciences |
| **Date SOP was written:** | 9/19/2013 |
| **Date SOP was approved by PI/lab supervisor:** | 9/19/2013 |
| **Principal Investigator:** | Steven Goodbred |
| **Internal Lab Safety Coordinator/Lab Manager:** | Richard Bradshaw |
| **Lab Phone:** | Click here to enter text. |
| **Office Phone:** | S. Goodbred (615) 322-4511 (campus phone: 2-4511) Bradshaw (615) 343-0839 (campus phone: 3-0839) |
| **Emergency Contact:** | S. Goodbred (615) 916-9259R. Bradshaw (208) 260-2792 |
|  |
| **Location(s) covered by this SOP:** | *SC6714* |
| *(Building/Room Number)* |

**Type of SOP:** ☒ Process ☐Hazardous Chemical ☐ Hazardous Class

**Purpose**

**Training/Authorization**

Only personnel who have:

- been authorized by Dr. Goodbred for the use of the XRF,

- completed XRF safety and operational training, and

- read and signed this SOP

may operate this device without supervision. All other users must be directly supervised by authorized and trained personnel.

Required training for this device includes:

1) Completing the appropriate on line X-ray Safety course in VandySafe initially (before first use) and annually thereafter.

2) Reading and signing this written procedure.

**Engineering Controls**

**Medical Emergency**

In any case where one suspects that the x-ray tube remains on when the measurement is terminated:

* Disconnect the battery pack immediately to turn off the x-ray tube, and
* Call Thermo Electron Corporation’s Service Department in the United States, toll free, at (800) 875-1578.

Known or Suspected accidental exposure to primary beam

* Notify VEHS Radiation Safety
* VEHS will assess impact and make further notifications if needed.

Severe Physical Damage

* There is no radioactive material so a fire or severe damage poses no radiation hazard
* If the XRF case is physically damaged, contact VEHS for a radiation survey to ensure the shielding has not been compromised; the device may not be used again until shielding integrity has been verified.

To contact the [Vanderbilt University Police Department](http://police.vanderbilt.edu/) in an emergency:

* Call **911** from any campus phone.
* Call **(615) 421-1911** from any other phone.

**Protocol/Procedure**

**Report any problems or abnormalities with the equipment immediately to the PI or LM.**

**\*\*\*NEVER leave the machine unattended while operating\*\*\***

Authorized Workers are responsible for using only approved safe techniques and procedures in operations involving the Analyzer. The specific actions to be performed are as follows:

1) Follow proper operating procedures as described in training and ensure other individuals also adhere to these requirements.

2) Ensure that the labels on the Analyzer are intact and legible.

3) Be familiar with emergency procedures and know how to recognize and terminate unsafe operations.

4) A copy of the User’s Manual or Operating and Emergency Procedures shall be made available to all workers using the NITON Analyzer. A copy will be kept with the Analyzer.

5) The operator is responsible for ensuring that no part of a person’s body is at or near the measurement point, and no closer than one foot during a measurement (trigger finger excluded).

6) The operator must be aware that the NITON Analyzer is emitting radiation when the four red LED lights are flashing. Contact Dr. Goodbred and Radiation Safety immediately if any of the LEDs do not flash during X-ray operation.

7) The operator must be aware that radiation in the primary beam could eventually cause physical harm if the device is used improperly and must be able to recognize the symptoms which would begin with skin reddening in the exposed area and at higher doses would appear as a burn or localized tissue damage.

**A. Bench Top (Test Stand with Enclosed Sample Chamber)**

After your sample has been oven dried at 50-60°C (NOTE: for muds, it may be beneficial to pack the mud in the XRF detector cup prior to drying):

1. Pack your sample into an XRF detector cup, using the wooden mallet to compress the sample in the cup as much as possible. Note that for very dense muds (brick-like), you can analyze the brick itself on the XRF without packing into a cup. You must have a flat surface to analyze, however. If you pre-packed a mud sample before drying, you may need to add more mud to fill the void space created in the cup with drying, or remove the plug and run like a brick as mentioned above.
2. On the PC, open the *blue* NDTr Program from the Start Menu. Check to see that the XRF is connected to the computer (USB connection).
3. Hit the Connect button.
4. Perform a system check, as prompted.
5. From the XRF Main Menu, Go to Advanced > Element Range and check (and save) the following parameters:

Mode: TestAllGeo

Times (s): Main Range – 30.0

 Low Range – 30.0

 High Range – 20.0

 Light Range – 40.0

1. From the XRF Main Menu, go to Start/Stop Settings and check to make sure the max time is same as the sum of all the TestAllGeo times (120s)
2. Open the top of the XRF stage, remove the blue cover and place a clean plastic sheet over the x-ray window. Replace the blue cover and place your sample in the cup holder. Close the top of the XRF stage.
3. From the XRF Main Menu > Analyze.
4. Check to confirm the XRF is connected to the PC (icon of the XRF stage = green, not red). Check the stage and USB connections if the icon is red.
5. Go to Data Entry (or hit the return button on the XRF screen) and enter your sample name.
6. Hit the start icon. A progress bar will indicate the completion.
7. Remove your sample and replace with the next one. Repeat steps 9-10 until finished. Clean the plastic cover over the x-ray window as needed with the soft brush.
8. When complete, hit the Disconnect button and close the program.
9. Clean the XRF stage with the brush and throw away used plastic film cover.
10. To download the data, open the NDT program from the Start Menu. Click Download. Query Readings. Select your samples of interest and fill in destination folder and file name. Make sure the box for “Simultaneous Download to MS Excel” is checked. Be sure to hit Download, not Done!
11. Close the program and shut down the computer.
12. Power off the XRF.

Troubleshooting tip: If you can’t get the NDTr software to connect to the XRF, check which COM port the XRF USB is plugged into using the device manager (rich click My Computer > Manage > Device Manager > Ports). On the NDTr (or NDT) software, you can select the port to be read (rather than unplugging the USB and checking each port manually).

**B. In situ measurements (i.e., using the XRF in the field):**

1. Turn on the XRF unit.
2. From the XRF Main Menu, Go to Advanced > Element Range and check (and save) the following parameters:

Mode: TestAllGeo

Times (s): Main Range – 30.0

Low Range – 30.0

High Range – 20.0

Light Range – 40.0

1. From the XRF Main Menu, go to Start/Stop Settings and check to make sure the max time is same as the sum of all the TestAllGeo times (120s)
2. Place the XRF against the sample of interest (outcrop wall, unconsolidated sample), making sure to direct any beams away from the body.
3. From the XRF Main Menu > Analyze.
4. Go to Data Entry (or hit the return button on the XRF screen) and enter your sample name.
5. Hit the start icon. A progress bar will indicate the completion.
6. Upon completion, remove the XRF from the sample. Data should be stored automatically, but you can also see and record measurements of interest (Sr, Fe, Ca, etc.) as needed.

**NOTE**

Any deviation from this SOP requires approval from PI.

**Documentation of Training** (signature of all users is required)

* Prior to conducting any work with the XRF, LM or designated personnel must provide training to his/her laboratory personnel specific to the hazards involved in working with this substance, and emergency procedures.
* The Principal Investigator must provide his/her laboratory personnel with a copy of this SOP.
* The Principal Investigator must ensure that their laboratory personnel have attended appropriate laboratory safety training and are current with any refresher training required.

I have read and understand the content of this SOP:

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| **Name** | **Signature** | **Identification** | **Date** |
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