# USGS NSF Internship Opportunity

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| **Point of Contact Name**: | Daniel H. Doctor |
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| **USGS Center:** | Florence Bascom Geoscience Center |
| **Project Title:** | Characterizing and dating manganese oxide deposits in the central and southern Appalachian Mountains |
| **Summary:** | Supergene manganese oxides are critical ore deposits that record valuable information about climate and geochemical processes at their time of formation. The intern's research will focus on characterizing and dating these minerals using scanning electron microscopy and 40Ar/39Ar geochronology. This work will have significant implications for understanding climate and erosional processes throughout the Cenozoic. |
| **Project Hypothesis or Objectives:** | Manganese oxide deposits have been recognized and mined in the Appalachian Mountains for over a century, yet their mechanisms of formation and alteration are not yet fully understood. Accurately modelling the nature and timing of manganese oxide formation is critical to testing recent hypotheses regarding tectonics and landscape evolution in the southern and central Appalachians. In addition, recent chemical analyses have shown these ores to be prospective sources for critical elements such as cobalt, beryllium, and rare-earths.<br><br>We propose to collect samples from numerous abandoned manganese oxide mines in Virginia and West Virginia. These deposits will be characterized using scanning electron microscopy and X-ray diffraction to test models of emplacement. Suitable samples will be dated with noble gas mass spectrometry to test proposed relationships between manganese oxide formation and shallow subsurface processes. Preliminary fieldwork at selected sites has already occurred and proven that successful samples can be obtained that will yield interpretable ages of mineralization. A targeted campaign of field and labwork can be easily accomplished in a 6-12 month time span in order to cover a wide geographic range and a number of depositional settings. |

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| **Duration:** | Up to 12 months |
| **Internship Location:** | Reston, VA |
| **Keywords:** | Chemistry, Climate Change, Geochemistry, Geology, Geomorphology, Hydrology, ground water, Mineralology, Paleoclimatology, Remote sensing |
| **Applicable NSF Division:** | GEO (Atmospheric, Earth Sciences, Ocean Sciences, Polar Programs), EAR, Earth Sciences |
| **Intern Type Preference:** | NSF-Funded MS or PhD student via the Non Academic Research Internships for Graduate Students program (INTERN) |
| **Duties/Responsibilities:** | The intern will be expected to locate manganese oxide mines, perform geochemical and geochronological analyses on collected samples, and develop robust models for manganese oxide emplacement. A list of visited sites, their structural and geochemical attributes, and geochronological results will be compiled in a database. The intern will collaborate in the preparation of publication(s) on the nature of manganese oxides in the Valley and Ridge and their implications for the Cenozoic history of the southern/central Appalachian Mountains. |
| **Expected Outcome:** | This project will provide novel age constraints on the formation of the enigmatic, widespread manganese oxide ores of the Appalachians, the source(s) of which have puzzled geologists for more than a century. Knowledge of the ages of these deposits will serve to provide crucial age constraints on portions of the Appalachian landscape and help to resolve long-standing debates about the mechanisms of landscape evolution, as well as paleoclimate change across the Appalachian region. The USGS will additionally benefit from characterizing the potential for these ores in abandoned mines to be suitable resources for critical elements, manganese chief among them, but also for cobalt, beryllium, and rare-earth elements. The intern will benefit from hands-on experience in the top-quality laboratory facilities of the USGS, and from mentoring by USGS scientists, both in the lab and in the field. |
| **Special skills/training Required:** | The intern will ideally have field experience and working knowledge of geographic information systems, scanning electron microscopy, and noble gas geochronology. Sites of interest will be identified using LiDAR data from the National Map database. Geologic maps will be used to identify structures and lithologies associated with the formation of manganese oxides. Sample collection will take place during the initial stages of the project. Prior to dating by 40Ar/39Ar geochronology, samples will be characterized via scanning electron microscopy coupled with elemental analysis by X-ray diffraction and energy-dispersive X-ray spectroscopy. The intern will be responsible for interpreting 40Ar/39Ar data generated by noble gas mass spectrometry at the Reston, VA office. |