



OFFICE OF  
**INSPECTOR GENERAL**  
U.S. DEPARTMENT OF THE INTERIOR

# **SCIENTIFIC INTEGRITY INCIDENT AT USGS ENERGY GEOCHEMISTRY LABORATORY**



OFFICE OF  
**INSPECTOR GENERAL**  
U.S. DEPARTMENT OF THE INTERIOR

JUN 15 2016

Memorandum

To: Suzette Kimball  
Director, U.S. Geological Survey

From: Mary L. Kendall *Mary L. Kendall*  
Deputy Inspector General

Subject: Final Report – Inspection of Scientific Integrity Incident at USGS Energy  
Geochemistry Laboratory  
Report No. 2016-EAU-010

The Office of Inspector General has completed an inspection of a scientific integrity incident involving the Inorganic Section of the U.S. Geological Survey's (USGS) Energy Geochemistry Laboratory in Lakewood, Colorado. This laboratory provides scientific support for the Energy Resources Program. Our objective was to determine the impacts of the incident.

During the inspection, we observed operations, analyzed data, and interviewed laboratory workers, managers, and laboratory customers to better understand the quantitative and qualitative impacts of the scientific integrity incident. Our review revealed that the full extent of the impacts are not yet known but, nevertheless, that they will be serious and far ranging. The impacts include publications that were retracted or delayed because of inaccurate information, potential damaged reputations of USGS and individual scientists, and possible lost collaborations with partners. We are making one recommendation to address the situation.

Please provide us with your written response to this report within 30 days. The response should provide information on the actions you have taken or planned to address the recommendation, as well as target dates and titles of the officials responsible for implementing these actions. Please send your response to [aie\\_reports@doioig.gov](mailto:aie_reports@doioig.gov). If you have any questions about this report, please contact me at 202-208-5745.

The legislation creating the Office of Inspector General requires that we report to Congress semiannually on all audit, inspection, and evaluation reports issued; actions taken to implement our recommendations; and recommendations that have not been implemented.

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## Results in Brief

We initiated this inspection to determine the impacts of a scientific integrity incident involving a U.S. Geological Survey (USGS) laboratory. The incident specifically concerned accusations of scientific misconduct and data manipulation by a mass spectrometer operator assigned to the Energy Resources Program's (ERP) Energy Geochemistry Laboratory in Lakewood, CO, in the Energy and Minerals Mission Area. The matter was discovered in late 2014, but had been taking place since 2008. This was the second such incident involving the same laboratory.

The Inorganic Section's work has implications for ERP's national and international coal and water quality assessments. Our review revealed that the impacts were far ranging, and included—

- publications that were retracted or delayed because of inaccurate information;
- potential damaged reputations of USGS and individual scientists;
- potential lost collaborations with outside organizations;
- diminished employee morale; and
- reduced public trust of USGS-generated information.

USGS is assessing the full impact of the incident on its research and assessment projects, an undertaking that will take time to complete. In addition, the Bureau has been notifying the affected customers, journals, and other end users, a protracted process that remains incomplete. USGS is pursuing disciplinary actions for the responsible staff.

Our report contains one recommendation.

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# Introduction

## Objective

Determine the impact on U.S. Geological Survey (USGS) customers, products, and organizational integrity resulting from scientific misconduct and data manipulation at the Energy Geochemistry Laboratory's Inorganic Section in Lakewood, CO, including—

- affected products published by the laboratory;
- affected customers, both internal and external;
- ultimate impact of identified issues on organizational integrity; and
- the process USGS will use to notify affected customers.

The scope and methodology are in Appendix 1.

## Background

As part of the USGS Energy and Minerals mission area, ERP researches and assesses the energy resources of the Nation and world. ERP's scientific work is supported by two energy centers, one in Virginia and the other in Colorado. The Central Energy Resources Science Center in Lakewood, CO, manages the Energy Geochemistry Laboratory, composed of separate inorganic and organic sections. The laboratory's Inorganic Section, however, closed in February 2016, following the scientific integrity incident that occurred there. The Inorganic Section, and in particular, its mass spectrometer operations, were the focus of this inspection.

The Inorganic Section (also known as the Inorganic Geochemistry Laboratory) functioned as a service lab in that it routinely processed samples for many scientists working on a variety of projects. The lab contained a mass spectrometer, a highly complex scientific instrument that identifies the chemical composition of a substance, as shown in Figure 1.

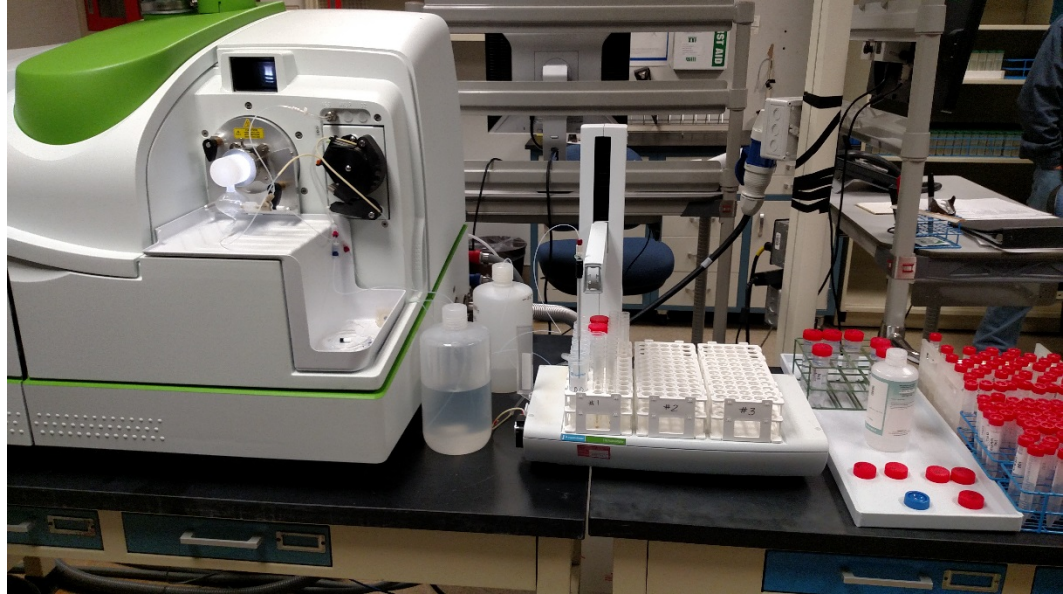


Figure 1. The mass spectrometer with samples prepared for analysis—the machine converts samples to a plasma state in order to analyze the components. Source: OIG.

A principal feature of a mass spectrometer is its capability to analyze multiple elements in a sample simultaneously and with a high level of precision. In the Inorganic Section, the mass spectrometer analyzed the inorganic chemistry of water samples and of extracts from solid samples such as coal and rock. Scientists used the sampling results to help understand and describe the substances located during their research and assessment projects. One chemist was principally in charge of operating the mass spectrometer for fiscal years (FY) 2008 through 2014 covered by our inspection.

During our inspection, the Inorganic Section employed a staff of three full-time scientists. In addition, a manager and two other employees served both sections of the laboratory.

Financial data associated with the Inorganic Section included—

- funding since FY 2008 totaling \$4.1 million;
- annual funding averaging \$590,000 since FY 2014;
- \$174,000 for a new mass spectrometer purchased in 2011 to replace the original unit for which acquisition documents were unavailable;
- \$144,500 paid to operate the mass spectrometer since 2008, with average annual expenses totaling approximately \$20,000; and
- \$656,100 paid by USGS since 2008 for the services of outside commercial laboratories that were often used instead of the Inorganic Section.

In 2014, OIG evaluated ERP's quality control process, issuing the final report (No. CR-EV-GSV-0003-2014) in May 2015. We found that ERP's system of quality assurance/quality control was insufficient to detect quality-related issues

in its science center laboratories. The report detailed two instances in which mass spectrometer operators in the Energy Geochemistry Laboratory's Inorganic Section had violated established laboratory practices without detection for many years. The initial incident involved scientific misconduct that began in 1996 and continued undiscovered until 2008. The second incident began in 2008 and continued undiscovered until late 2014. This inspection focused on the second incident.

Following discovery of the second incident, ERP management issued a stop work order for the laboratory and began an internal investigation. The USGS Office of Science Quality and Integrity likewise issued a stop work order and initiated an "inquiry" in accordance with departmental policy. As part of the inquiry, USGS convened a Scientific Integrity Review Panel to further investigate the matter. The report of inquiry concluded that the laboratory had a "chronic pattern of scientific misconduct" and that "data produced by the Inorganic Section were intentionally manipulated by the line-chemist in charge." The identified issues predominantly affected coal and water quality research and related assessments.

Once the results of the inquiry became known, USGS closed the Inorganic Section, effective February 25, 2016. Along with the closure, the agency initiated personnel actions, started determining what should be done with the lab equipment, and began notifying end users of potentially suspect data generated in the lab. USGS currently is assessing the full impacts of the incident on affected research and assessment projects, a process that will take some time to complete.

USGS accused the chemist of data manipulation by intentionally changing the results produced by the mass spectrometer. The chemist also failed to preserve the data. Further, the Bureau accused the chemist of failing to operate the mass spectrometer according to established practices, which constituted scientific misconduct.

These two actions created the larger issue of loss of scientific integrity, a concern referenced in USGS' inquiry. Scientific integrity is at the core of the mission of USGS. Also, given the widespread use of USGS data and publications by its many customers, scientific misconduct at the Inorganic Section has serious implications for energy and environmental decisions driven by information developed at the laboratory.

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# Findings

The recent scientific integrity incident has had numerous real and potential adverse impacts on customers, products, and the organizational integrity of USGS, as these pertain to coal and water quality research and assessments. We noted, among those impacts, that one research paper that was ready for publishing had to be retracted; certain scientists stopped preparation of scientific papers; the lab's data manipulation issues negatively impacted the reputation of numerous researchers; and the loss of scientific integrity potentially may damage the stature of USGS, both nationally and internationally. The results of USGS' internal inquiry are consistent with our own findings.

## Products Affected

In conducting research and assessment projects, scientists rely on the accuracy of information provided by ERP's laboratories. Since ERP data is used to support both scientific decision-making and understanding, inaccurate data has significant scientific consequences. The affected coal and water quality related work products from this scientific integrity incident included the following:

- Twenty-four research and assessment projects that have national and global interest were potentially affected by erroneous information. A list of each project is contained in Appendix 2. These affected projects represented about \$108 million in funding from FY 2008 through 2014. ERP officials stated that they were in the process of assessing the impacts on each project for determining future actions. Among the projects—
  - toxic trace metals analysis of water in the greater Everglades ecosystem in Florida;
  - assessment of uranium in the environment in and around Grand Canyon National Park in Arizona for possible groundwater restoration;
  - analysis of coal combustion byproducts relating to the nationwide Geochemistry of Solid Fuels project; and
  - analysis of metals released into waters associated with coalbed natural gas production activities in Alaska.
- At least seven reports have been delayed and, to date, one report has been retracted. The retracted report was on air quality studies relating to feed coals in South African boilers as part of a United Nations Environmental Program study.

ERP's publications serve an important role in understanding domestic and international energy resources, and can directly influence energy-related decisions and strategies of its diverse stakeholders, who include universities, the public, and Government agencies.

In addition, customers of the lab expressed frustration that the lab required an inordinate amount of time to process the samples they had submitted. The



Inorganic Section's mass spectrometer processed approximately 3,800 samples since 2008. The customers complained that processing times were often 6 months or longer, versus the more customary turn-around time for service labs of about 30 days.

## Customers Affected

The USGS mission is to provide the Nation with reliable scientific information, and the Bureau highly values the reputation it has built. This incident of scientific misconduct and data manipulation in a major USGS laboratory, however, potentially undermines the Bureau as a trusted scientific organization. Although management discovered the incident in late 2014, our review disclosed that employees had suspected quality-related problems with the laboratory for many years. In our interviews, USGS employees consistently voiced their distrust of the lab. The employees also expressed their preference not to use the inorganic laboratory and, instead, to use other USGS laboratories or outside commercial laboratories.

The people most directly affected by the scientific integrity incident were the researchers who submitted samples to the inorganic laboratory for analysis. The incident at the lab placed at risk the validity of the determinations and conclusions made by these scientists.



Figure 2. Samples arrived at the Inorganic Section to be prepared for analysis by the mass spectrometer. Source: OIG.

Thirty-three individuals submitted samples processed by the Inorganic Section's mass spectrometer, as shown in Figure 2. Most of these were USGS scientists stationed in the science center in Reston, VA, with a smaller number from the center in Lakewood, CO. Several customers worked for other organizations, including the National Geospatial-Intelligence Agency, the State geological survey offices of Pennsylvania and Wyoming, and Southern Illinois University. We interviewed 16 customers, nearly all of whom expressed disappointment,

anger, and/or distrust of the lab. Many stated in very strong terms they would not use the lab if it reopened. These individuals also cited—

- reduced confidence of collaborators in USGS-generated data, as well as providing fuel for critics of USGS;
- Bureau embarrassment, especially since similar issues have occurred twice in the same laboratory;
- upset in the Organic Section because of the perceived connection between the Inorganic and Organic Sections;
- undermining of public trust, as well as that of other scientific organizations;
- impact on morale of scientists, in spite of reassurances after the first incident that such a situation would not occur again; and
- personal impact on post-doctoral researchers working for USGS.

In a broader sense, the affected customer base comprises all end users of ERP's products. The end users are numerous and diverse. ERP's strategic plan lists more than 200 specific customers, partners, and cooperators of the program. For simplification, we grouped these stakeholders into the following categories—

- U.S. Department of the Interior bureaus and other Federal agencies;
- other USGS program areas;
- State geological surveys and other State agencies;
- general public;
- American Indians;
- domestic and international energy industry community;
- news media;
- environmental community;
- nongovernmental organizations;
- domestic and foreign academia; and
- U.S. Congress

Within the above categories, the strategic plan lists numerous agencies, offices, businesses, universities, and institutions. Depending on the stakeholder, ERP's publications can be used by the public for general informational purposes; by academics to further the understanding of energy resources; by specialists to provide input for industry business decisions; or by the Government for policy, regulation, and rule making.

## **Ultimate Impact on Organizational Integrity**

Along with the aforementioned effects on products and customers resulting from the scientific integrity incident, we determined that the scientific misconduct and data manipulation at the lab also impacted USGS organizational integrity in ways

that are still unfolding and challenging to quantify. We did identify the following ultimate impacts—

- unreliable scientific publications generated from research and assessment projects that relied on the laboratory; projects often take five or more years to complete and may result in multiple publications;
- delayed completion of ERP’s research and assessment projects, including, for example, coal assessments in the Appalachian Basin in the eastern United States;
- permanent loss of unique rock and water samples collected in the field—because of access restrictions to some areas and the sometimes short-lived nature of substances, USGS researchers may be unable to obtain replacement samples (e.g., a scientist who acquired samples from Jackson Dome, Mississippi, said she cannot return to the area because of landowner access issues);
- diminished public trust in Federally-led scientific endeavors;
- lost time and effort of scientists who worked on the affected projects;
- wasted time and expense associated with reprocessing salvaged samples, reassessing the results, and reissuing publications;
- damaged personal reputation of scientists; and
- possible weakened or lost collaborations with Federal and state agencies, universities, and foreign nations.

## **Notification of Customers**

In a memo to the USGS Director dated January 19, 2016, the Southwest Regional Director announced several actions regarding the Inorganic Section:

- USGS would close the Inorganic Section, effective February 25, 2016.
- End users of the Inorganic Section were being notified that the data was suspect and any publications should be evaluated and possibly retracted.
- ERP was working with the USGS Office of Communications to develop an announcement for the Bureau’s website about the suspect data and lab closure.
- USGS was developing proposed disciplinary actions for employees of the Inorganic Section.

If ERP’s impact assessment shows that incorrect conclusions were reported, ERP stated that it will directly contact journals that published the papers, as well as any collaborator.

In addition, we noted that USGS has taken a long time to inform its many stakeholders about this scientific integrity incident. To date, only the direct lab customers as well as selected scientist collaborators and related journals have been notified. Considering that the incident was discovered in October 2014 and that its serious nature became apparent shortly thereafter, USGS has had ample

time to make a public announcement. Many organizations rely on USGS publications and could potentially make decisions or policy based on flawed information.

### **Recommendation**

We recommend that USGS:

- I. Complete the notification to stakeholders of the scientific integrity incident.

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# Conclusion and Recommendation

## Conclusion

This scientific integrity incident has had numerous real and potential adverse impacts on customers, products, and the organizational integrity of USGS, as these pertain to coal and water quality research and assessments. Nevertheless, quick and decisive action on our recommendation will help restore confidence in the Bureau.

## Recommendation Summary

We recommend that USGS:

1. Complete the notification to stakeholders of the scientific integrity incident.

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# Appendix I: Scope and Methodology

## Scope

Our scope covered the impacts of the scientific integrity incident in the Inorganic Section of the Energy Geochemistry Laboratory as it relates to USGS customers, products, outside agencies, and others, including the extent of the impact and the products affected.

Our inspection covered the period from FY 2008 through 2015.

## Methodology

The USGS Office of Science Quality and Integrity officially referred this misconduct incident to OIG in October 2015.

To fully develop the findings, the team—

- identified the products potentially impacted by scientific misconduct/data manipulation;
- identified affected customers both internal and external to USGS;
- identified requests for analysis sent to, or completed by, the Inorganic Section since 2013 (2 years prior to suspension of the laboratory);
- identified other reports issued that pertained to laboratory deficiencies;
- interviewed the USGS Director and key management officials of ERP and its science centers in Reston, VA, and Lakewood, CO;
- interviewed the Office of Science Quality and Integrity's director and his assistant;
- interviewed selected employees and customers of the inorganic lab; and
- toured the inorganic lab to observe its operations.

Our work focused on understanding the full impacts of the scientific integrity breach on USGS customers, products, and organizational credibility; understanding USGS' process for addressing product misinformation; and determining actions that USGS will take regarding the laboratory.

We visited the following USGS offices as necessary to accomplish the objective:

- Headquarters, Reston, VA;
- Energy Resources Program, Reston, VA;
- Office of Science Quality and Integrity, Reston, VA;
- Eastern Energy Resources Science Center, Reston, VA; and
- Central Energy Resources Science Center, Lakewood, CO (location of the Energy Geochemistry Laboratory).

We also made telephone contacts with individuals stationed in other locations, including all four members of the Scientific Integrity Review Panel.

We conducted our inspection in accordance with the Quality Standards for Inspection and Evaluation as put forth by the Council of the Inspectors General on Integrity and Efficiency. We believe that the work performed provides a reasonable basis for our conclusions and recommendations.

## Appendix 2: Projects Potentially Impacted

Project Name	Project ID	Collaborators
Coal Util. & Critical Coal Quality Issues	7330-53573 & 8930-0IG80 (Brownfield)	N/A
Link land, air, water in Florida	2920-CTFWO; GxI Inm00-CTFWOO; Shark River 2011; 2920-0H704; Sulfur Toxics/29; Greater Everglades Priority Ecosystems; FL_Canals_April_2012; Florida Canals & Transects_July 2012	N/A
EPA Palos Verdes	EPA Sproul Cruis	U.S. Geological Survey, Reston, VA; S.S. Papadopoulos & Associates, Bethesda, MD; U.S. Geological Survey, Menlo Park, CA; U.S. Geological Survey, Santa Cruz, CA; U.S. Geological Survey, Woods Hole, MA; Civil & Environmental Engineering, Stanford University, Stanford, CA; Department of Environmental Sciences, Xi'an Jiaotong-Liverpool University, Jangsu Province, PRC; Center for Geomicrobiology, Aarhus University, Aarhus, Denmark
Afghanistan Coal Assessment	Afghanistan Coal Assessment	Afghan Geological Survey; USAID
Coal Resource Assessment Methodology	2920-0HEBC Task	N/A
CGS Colorado ROMs	CGS Colorado ROMs	N/A
PATASIC / Pa. Geological Survey (PAGS), DCNR	PATASIC	N/A
ERIC GCM11MI009Z	ERIC GCM11MI009Z	N/A
NGA-IBG	NGA-IBG	N/A



Project Name	Project ID	Collaborators
Southern Illinois University	Southern Illinois University	N/A
7230-53573	7230-53573	N/A
8932-ANX22 / NIST 8932-ANX2	8932-ANX22 / NIST 8932-ANX2	N/A
Petroleum Processes Research	Petroleum Processes Task 4; 2920-C4510; Origin and controls on natural gas	N/A
Energy Geochemistry Laboratory (EGL); Geochemistry Laboratories	Canspex	N/A
Health Effects of Energy Resources	Gx11nm00-DN4200; Gx11nm00-DN42000; 2920-0H600; 2920-0H704; Health Effects o; Mussels Project; WV_DEC_2012; GX13NM00DN42000; GX13NM00FH40100; BEN 2011 / GX12NM00DN42000; WVA – August 2011 / GX12NM00DN42000; WV Dec 2011; WV_Feb_2012; WV_May_2012; WV August 2012	N/A
Alaska Rural Energy	Alaska Rural Energy	N/A
Geochemistry of Solid Fuels	AC0000M MENDENHALL; NM00EAH; South African Coals; WoCQI - Tanzania; GX13NM00EAH7000; 8930-c4e6a; Afghanistan Coal Assessment; EAH4000 – Geochemistry of solid fuels	UNEP; ESKOM; ADAES, Inc.; IEA Clean Coal Centre; U.S. Geological Survey, Reston, VA; University of Texas at Dallas, Richardson, TX; Craton Resources (Pty) Ltd., Lobatse, Botswana; Department of Geological Survey, Economic Geology Division, Lobatse, Botswana; Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil; Kiwira Coal Mines, Mbeya, Tanzania; University of

Project Name	Project ID	Collaborators
		Zambia, Lusaka, Zambia; Minufiya University, Sadat City, Egypt; Ministry of Energy and Minerals, Dodoma, Tanzania; University of Botswana, Gaborone, Botswana; Afghan Geological Survey
Uranium in the Environment	8930-C5G1A/Otton; ISL Samples, XRD; Uranium Environmental Task; GX11RM00DZ51A00; Uranium 8930-DZ5; Mendenhall_8930-AEW2F	CSM student
Gulf Coast Framework Studies	2920-BNVGC – Gul; Gulf of Mexico Oil and Gas Asst.	Genesis Gas & Oil LLC, Kansas City, MO
National Assessment of Oil and Gas Resources (NOGA)	89300IE National Assessment of Oil and Gas Resources; 8930-com01	Hess Corp.
US Coal Resources and Reserves Assessment	US Coal Assessment Project, Task 2	N/A
State Co-ops	29200HF20	N/A
Produced Waters	Produced Waters	N/A
Geologic CO2 Sequestration	Carbon Sequestration-Geologic Research & Assessment	Denbury Resources

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