INNOVATIVE INTEGRATED INSTRUMENT FOR CHARACTERIZING RARE EARTH ELEMENTS BUILT AND TESTED

The instrument is anticipated to be a breakthrough in the rapid in situ detection of rare earth elements in coal and in a myriad of other REE-related applications.

INNOVATIVE PORTABLE INSTRUMENT ENABLES FIELD ANALYSIS OF RARE EARTH ELEMENTS (REE) IN COAL-RELATED MATERIALS

Applying their expertise in integrated laser induced breakdown spectroscopy (LIBS) and Raman spectroscopy instruments (e.g., 2020 Mars Rover), Los Alamos National Laboratory (LANL) has completed the assembly and testing **of a prototype field-portable LIBS and Raman spectroscopy backpack instrument**. This device is capable of **simultaneous chemical and mineralogical analysis** of REE in coal-related materials **in the field**.

Left: The field-portable LIBS and Raman (backpack) prototype unit undergoing field testing. Right: Close-up of the field-portable unit.

## ALL RESEARCH AND DEVELOPMENT OBJECTIVES SUCCESSFULLY ACHIEVED

The **primary objectives** of this research and development effort were to:

1. **Develop and test** analytical protocols for analyzing the concentration and mineralogy of REE in coal-related materials using LIBS and Raman spectroscopy.

2. **Develop a prototype field-portable system** for LIBS and Raman analysis of REE in coal-related materials.

3. **Analyze the chemistry and mineralogy of REE** in a variety of coal-related materials, principally from New Mexico coal deposits.

INSTRUMENT TECHNOLOGY METHODOLOGY VALIDATED

LANL **successfully developed** a method using fluoroboric acid to digest coal, coal fly ash, and geological samples for REE analysis using inductively coupled plasma mass spectrometry (ICP-MS).

Fluoroboric acid preparation and ICP-MS analysis were validated against reference materials and shown to be very accurate. End-to-end performance and functional testing of the device, as well as field testing, were completed.
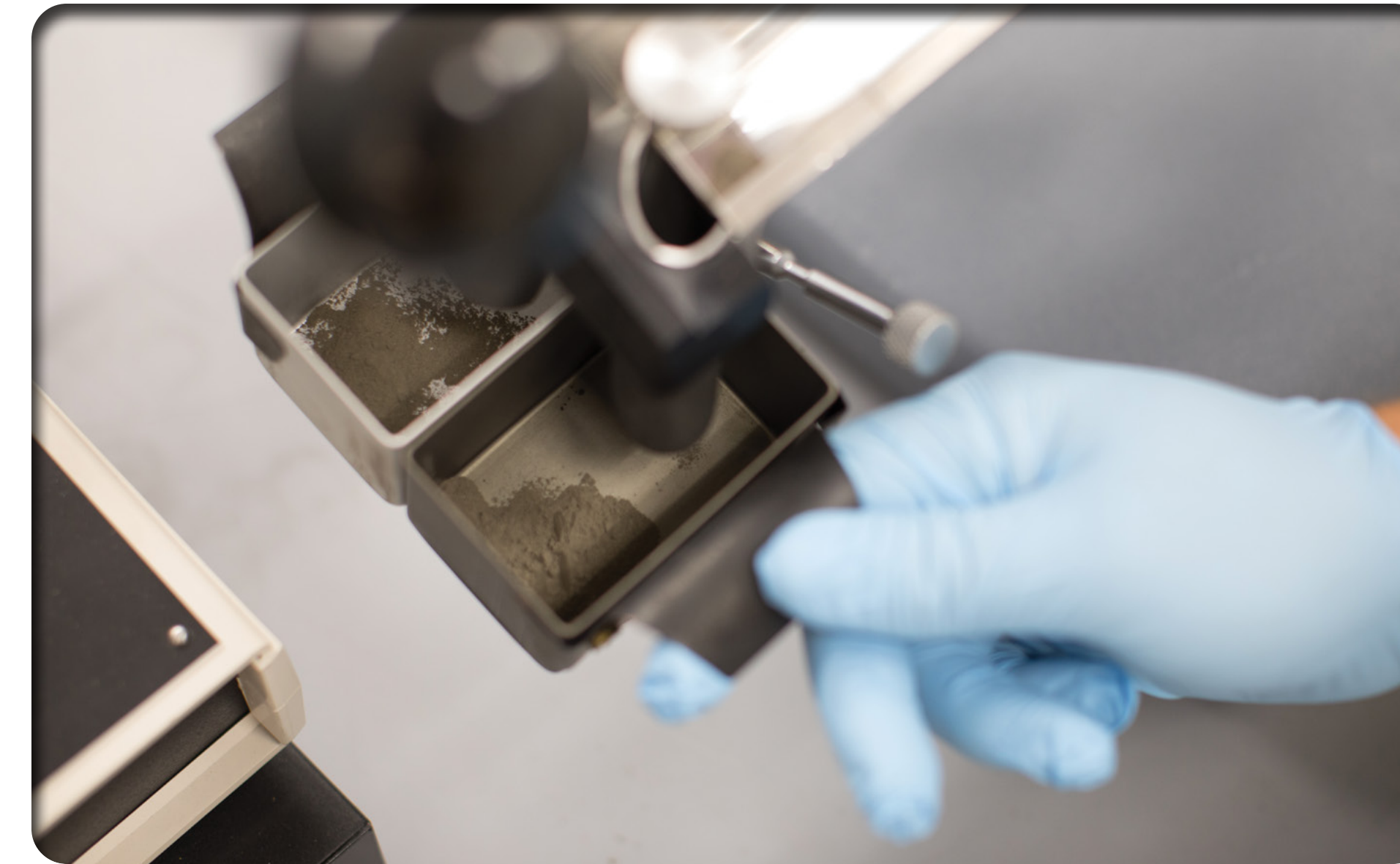
Sensor technology is anticipated to have applications in REE processing.

SENSOR PACKAGE IS ANTICIPATED TO HAVE BROAD USE BEYOND THE PROJECT OBJECTIVES

Sensor packages such as this will be useful in many applications besides REE detection in coal including:

- **Monitoring** of REE content in process streams.
- **Detection** of upsets during industrial processing.
- **Rapid testing and validation** of new extraction or separations techniques.

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