Los Alamos Joint Genome Institute finishes landmark genome

by Katherine Harrington, B-5

Los Alamos researchers on the Department of Energy's Joint Genome Institute (JGI) team recently finished the 50th microbial genome since they began "finishing" in 2003.

Fifty of the 100 genomes completed by the Joint Genome Institute were finished at Los Alamos.

The 50th genome, finished in July, was the microorganism Polaramonas naphthalenivorans. It is known for its ability to degrade naphthalene, a carcinogen commonly found at DOE's energy production sites. Genetic information about Polaramonas naphthalenivorans will help researchers who are seeking insight into how naphthalene degrading microbes could be used to manage contaminated ecological and industrial environments as well as understanding how organisms survive in highly contaminated environments.

Some 354 microbial genomes have been sequenced worldwide since scientists finished the first microbial genome in 1996. The "finishing" process involves filling gaps that remain after the draft sequencing phase, which occurs at the Production Genomics Facility in Walnut Creek, California, the main facility of the Joint Genome Institute.

Innovative computational strategies and chemical reactions developed by Laboratory scientists are used in the finishing process. The genomes that JGI selects to finish are selected on the basis of their potential to advance research in DOE's carbon sequestration, bioremediation, bioenergy, radiation resistance, animal pathogen and metal reduction mission areas. JGI research is supported by DOE's Office of Science- Biological and Environmental Research Program as well as by 'work for others' projects.

Laboratory scientists in Genomic Sequencing and Computational Biology (B-5) began finishing sequences in 2003. Since then, the technology and chemistry techniques have evolved significantly. Over the years, more parts of the process have been automated, which has resulted in faster production rates. David Sims of B-5 works on the computational part of the finishing process. He said that when the project was first starting, the team was only able to produce one genome a year. Team members are able now to finish about one a week. JGI Lab scientists also learned different chemical techniques, which allow them to overcome obstacles and produce more cohesive, higher quality data. The team also developed a database, which has improved the quality of the data the team produces and the efficiency with which it is able to finish genomes.

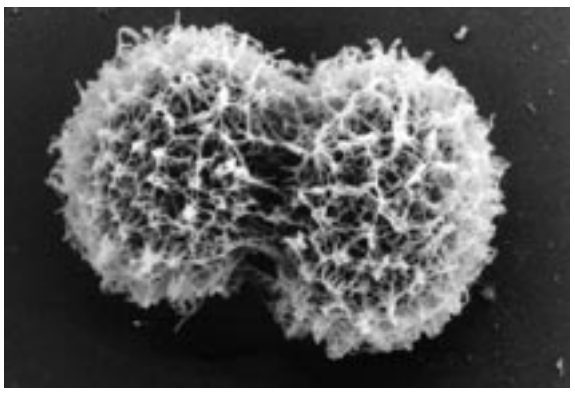
As the Los Alamos JGI team continues to increase efficiency and automation in sequencing simple microbial genomes, such as bacteria, it will be able to tackle more complex genomes, including yeast and other fungi. "That's what is on the horizon for us," said Sims.

Of the 50 genomes finished, some of the organisms Los Alamos has sequenced are used in bioremediation to clean up oil spills or other such pollutants from the environment. For example, Pseudoalteromonas atlantica has been studied off the coasts of California, New Jersey and Florida and has been shown to absorb twenty to forty percent of trace metal lead in ocean environments. Having the finished sequence of P. atlantica, researchers will be able to better understand the microbe's function in controlling toxic metal concentrations.

Microbes might also help carbon sequestration researchers better understand the fate of greenhouse gases and may help them develop techniques for reducing the buildup of these gases in the atmosphere.

One microbe, Sphingopyxis alaskensis, is found in nutrient deficient waters near Alaska, the North Sea and the North Pacific. It is able to survive in these nutrient-deficient waters because of its ability to feed on atmospheric carbon. Researchers are interested in studying these types of microbes in order to predict how various ecosystems might respond to nutrient deficiencies caused by global warming.

Microbes useful in bioenergy work are attractive for their ability to convert organic matter into renewable energy. The microbe Syntrophomonas wolfei Gottingen, which was recently finished at Los Alamos, produces hydrogen and methane as by-products of its metabolism. Both of these materials might be burned as clean fuels or used in fuel cells. By studying these microbes, scientists also have begun developing technology to imitate their processes to create renewable, less expensive energy sources.



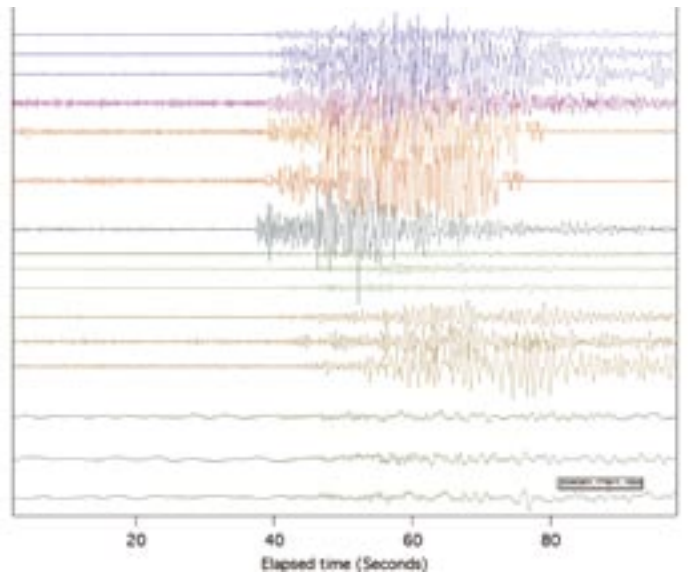
Pictured is the 50th microbial genome, Polaramonas naphthalenvironans, that Los Alamos researchers on DOE's Joint Genome Institute (JGI) team recently finished. *Photo courtesy of JGI*

Although many of the microbes finished by the Joint Genome Institute have uses in energy and the environment, some are sequenced because of their relevance to public health and health security as part of Laboratory 'work for others' efforts.

Francisella tularensis Wyoming was selected to provide insight into its pathogenicity and to enable medical professionals to better diagnose and treat human disease, Tuleremia. Tuleremia, which is contracted through insect bites, handling of infected animals, ingestion, and inhalation, has a thirty to sixty percent mortality rate, but is relatively easy to treat if diagnosed early enough.

Furthermore, the sequencing of Bacillus anthracis and its relatives has given researchers detailed information that is useful in helping law enforcement scientists distinguish between deliberate anthrax attacks and those that develop from naturally occurring strains.

In a letter congratulating the JGI on its accomplishments in finishing, Daniel Drell, of the Life and Medical Sciences Division of DOE (part of DOE's Office of Science-Biological and Environmental Research Program) wrote: "No one questions the position of the DOE-JGI at the vanguard of genomic sequencing (microbial and otherwise). You do it faster, you do it better, and you do it cheaper than anyone else, and you do it for a more diverse range of scientific projects than any other operation and any other agency. And you do it for the scientific community."



The recordings are displacement (vertical axis) versus time. Most seismographs measure motion along three difference axes. In this image, the three brown lines represent one instrument, while the the blue and red lines represent other instruments. *Image courtesy of EES-11*

Earthquake ...

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- Hold on until the shaking stops.
- Stay away from windows.
- Stay away from unsecured furniture that can fall.

If outdoors

- Stay there
- Move away from buildings, street lights, and utility wires

If in a moving vehicle

- Stop as quickly as safety permits and stay in the vehicle
- Avoid stopping near buildings, trees and utility wires
- Avoid roads or canyon sites near rock walls

After an earthquake

Emergency Response (ER) Division will initiate Laboratory response activities, including an engineering safety assessment of Lab buildings and structures. However, immediately following an earthquake, employees should be aware of the following:

- Expect aftershocks. These secondary shockwaves can be strong enough to cause additional damage to weakened structures.
- Open cabinets cautiously. Beware of objects that can fall off shelves.
- Stay away from damaged areas.
- Expect lights and electric power to be out.

For more information, contact Volkman at 7-6238.