



BIG TIME ATTIC  
PRESENT

# THE GREAT TUNNEL JOURNEY A RACE TO THE TUNNEL



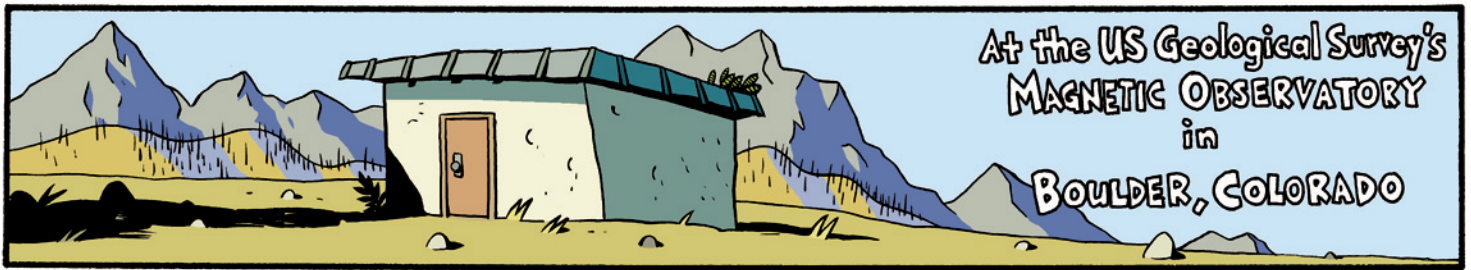
# Journey along a field line



Written and produced by BIG TIME ATTIC  
and Jeffrey J. Love of the  
US GEOLOGICAL SURVEY.

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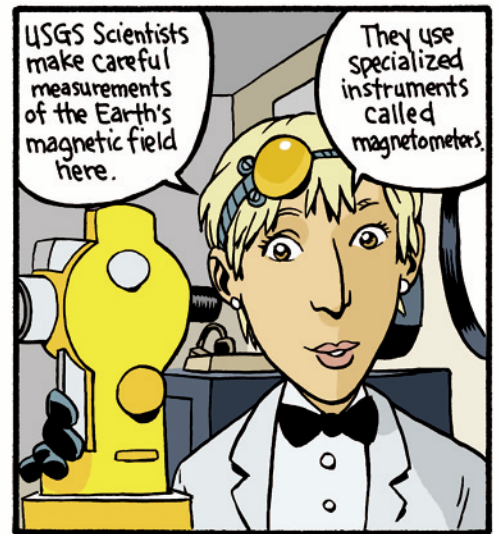


At the US Geological Survey's  
**MAGNETIC OBSERVATORY**  
in  
**BOULDER, COLORADO**



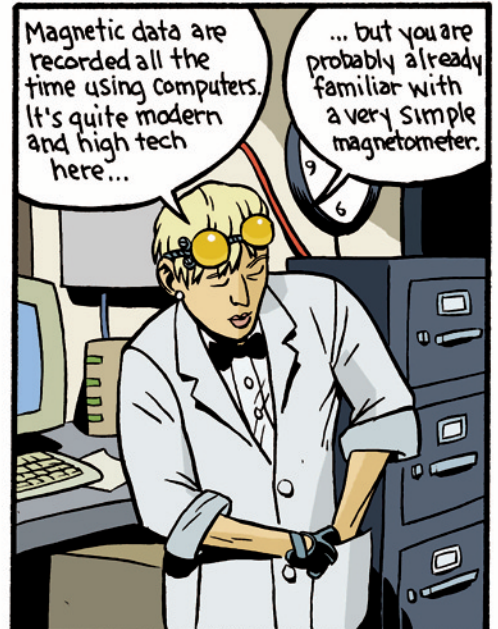
Hi  
there,  
everyone.  
WELCOME!

I'm Zillian  
Rocket, Scientist,  
and I'm checking out  
magnetic data from  
the Boulder  
Observatory.



USGS Scientists  
make careful  
measurements of  
the Earth's  
magnetic field  
here.

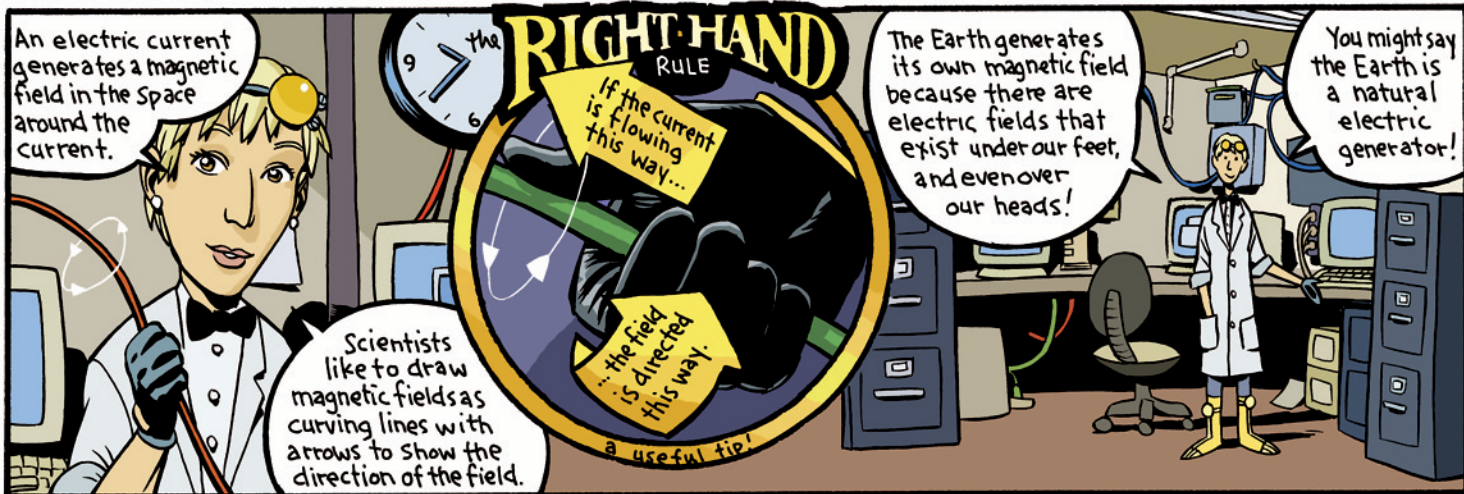
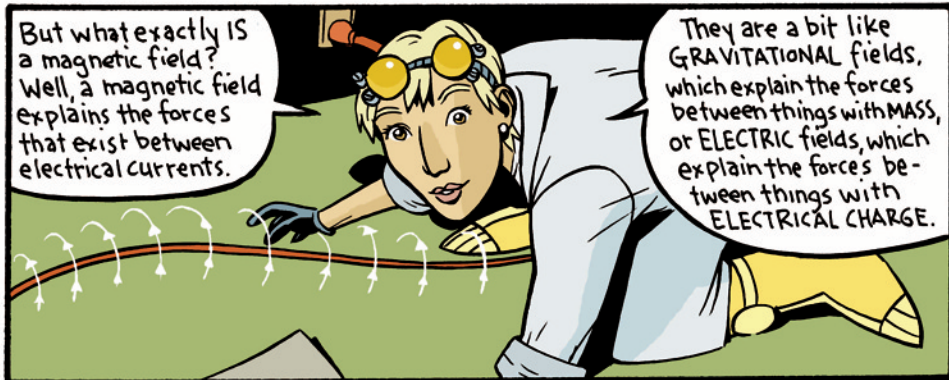
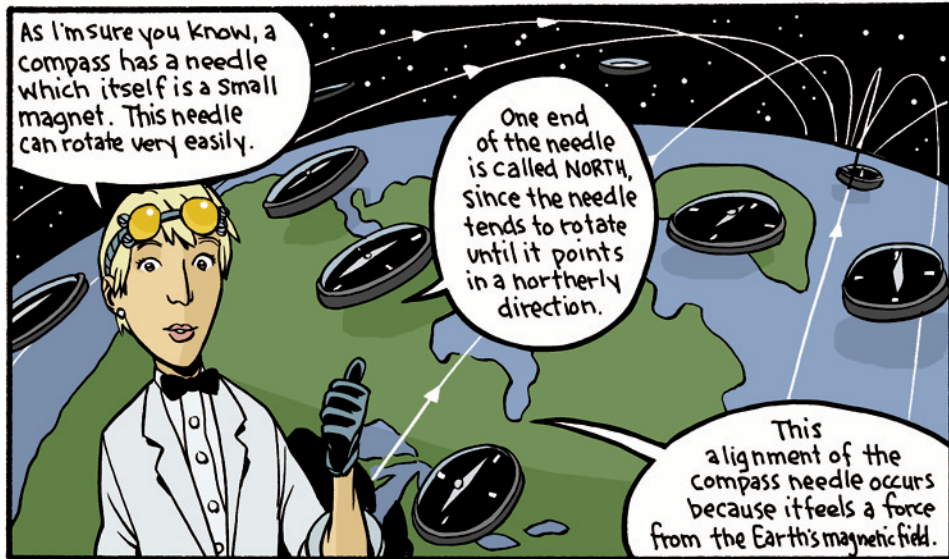
They use  
specialized  
instruments  
called  
magnetometers.



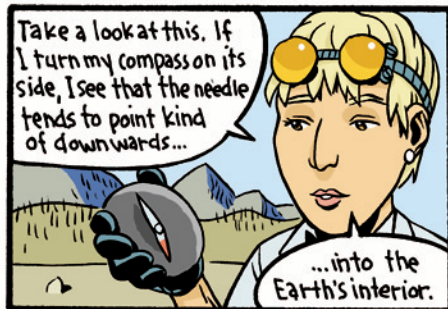
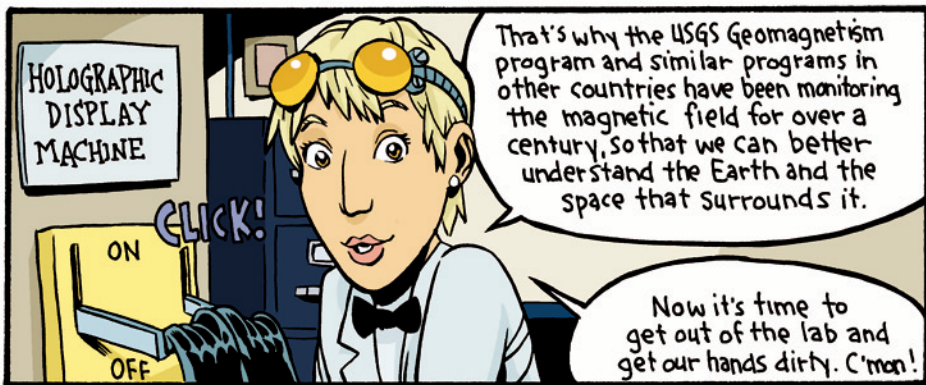
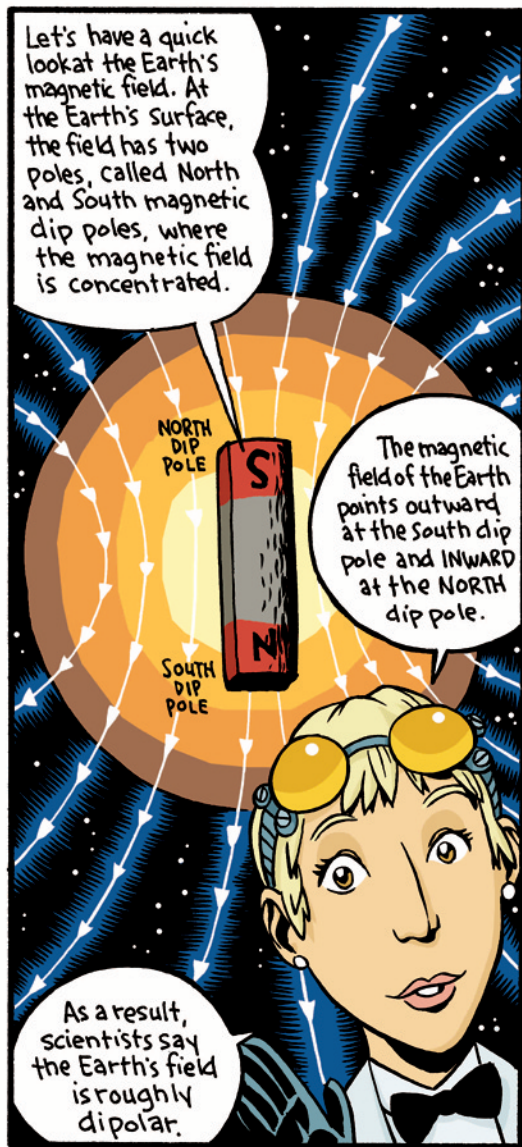
Magnetic data are  
recorded all the  
time using computers.  
It's quite modern  
and high tech  
here...

... but you are  
probably already  
familiar with  
a very simple  
magnetometer.

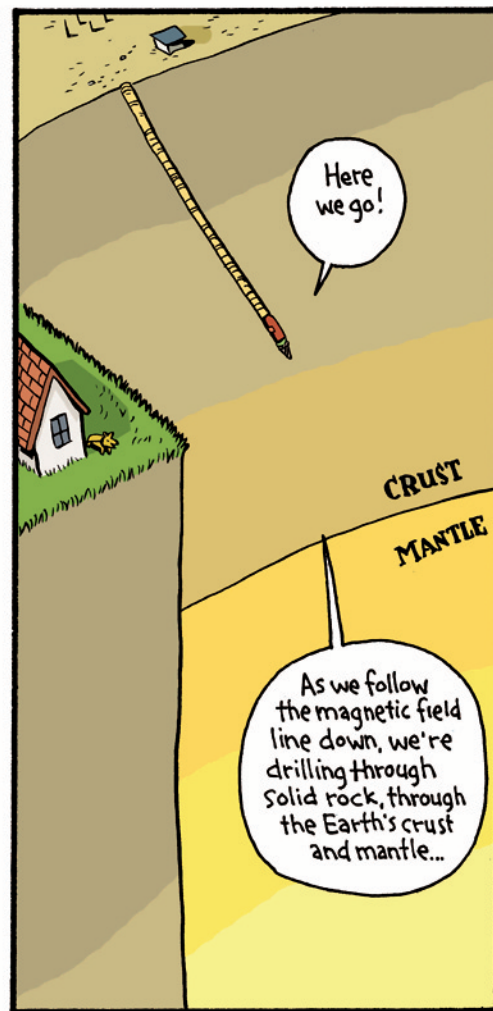
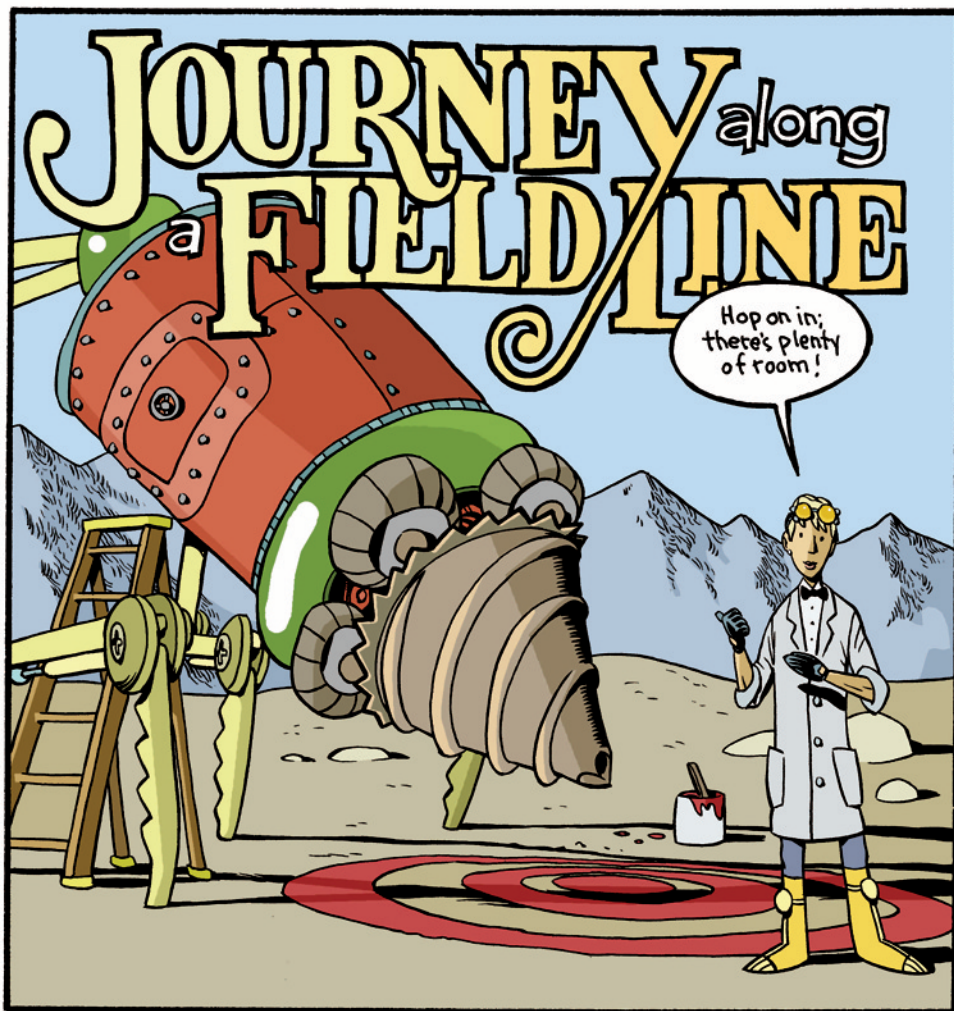




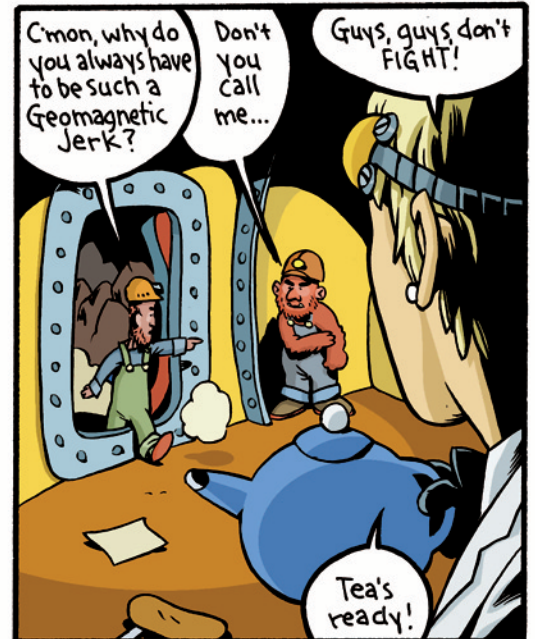
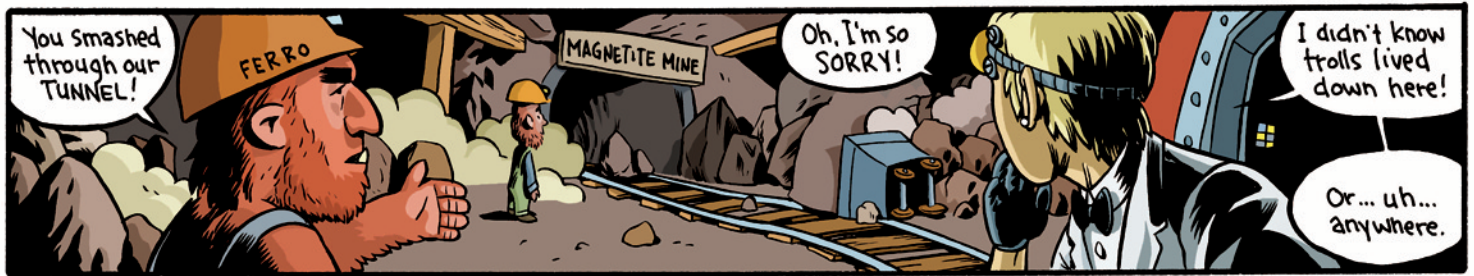
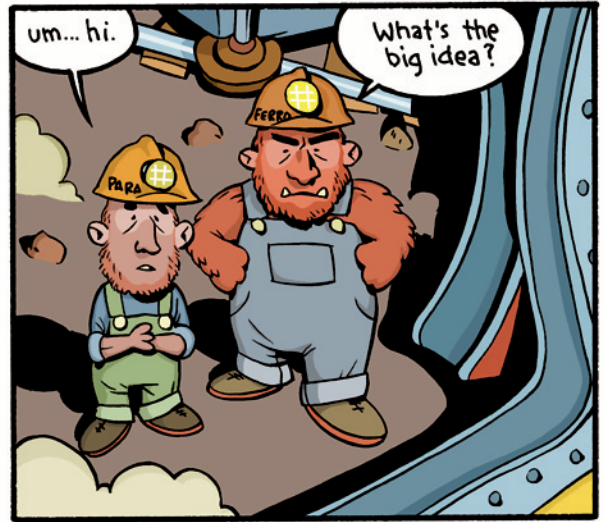




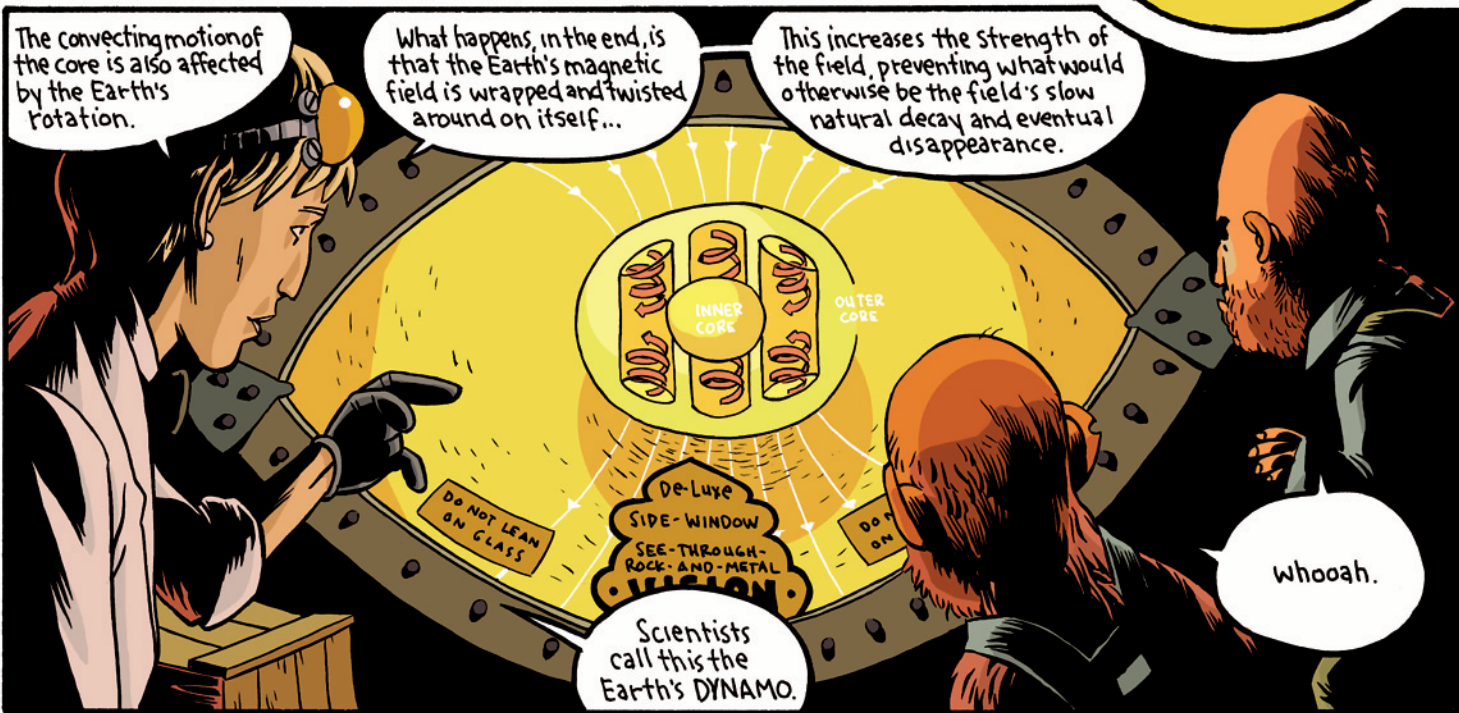
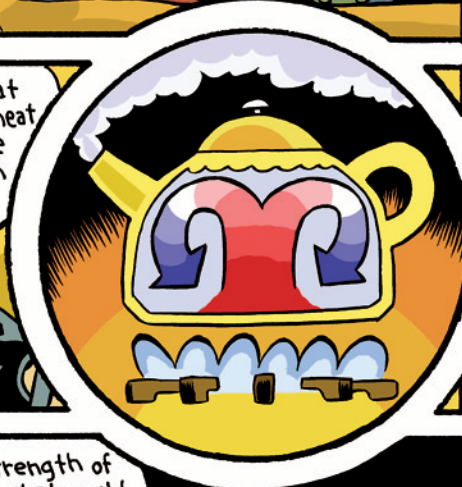
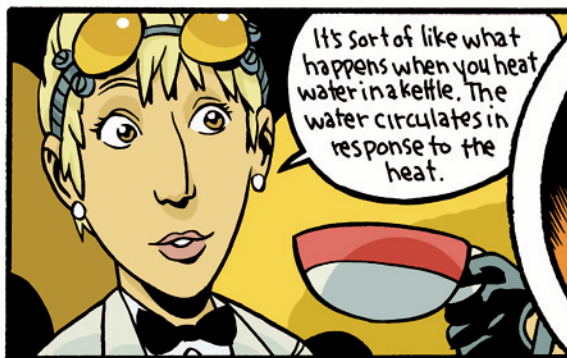
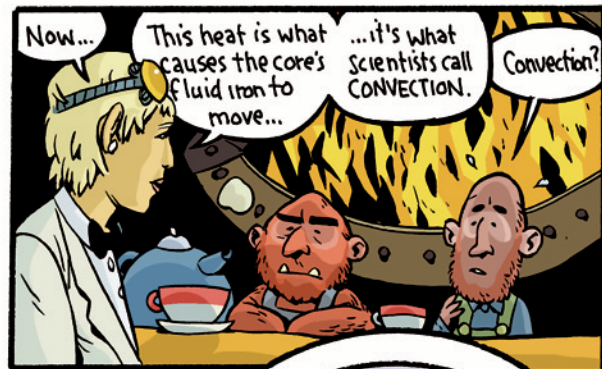
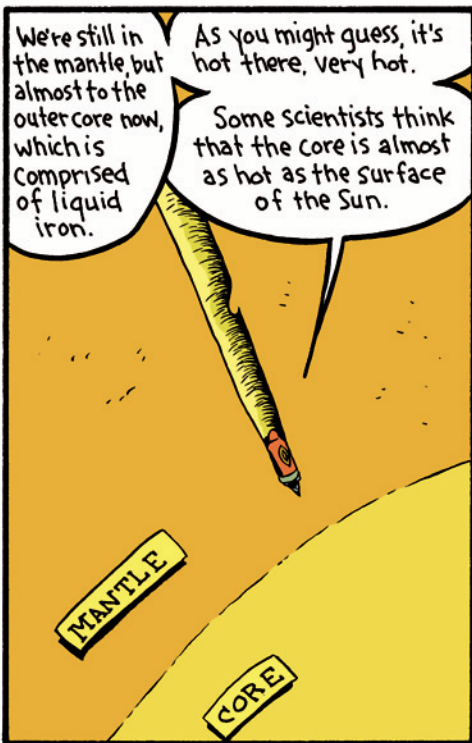




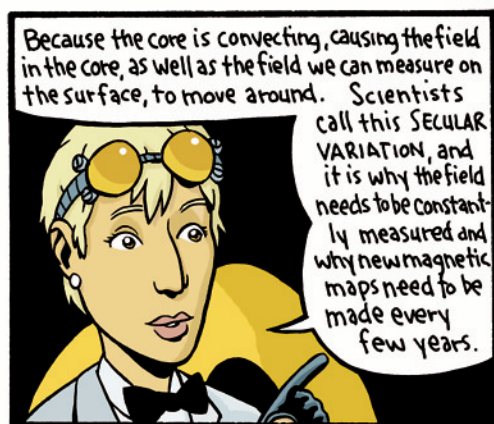
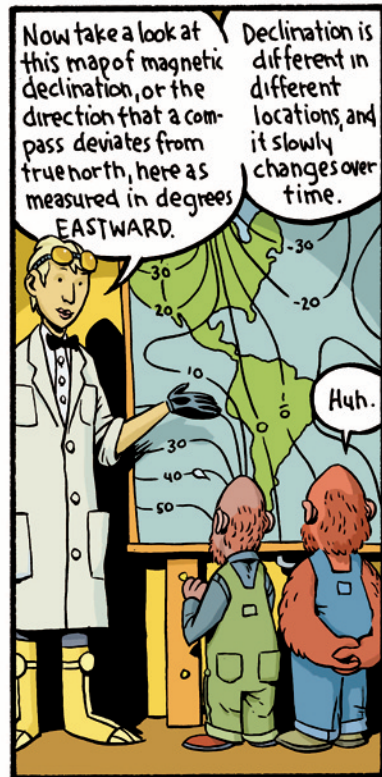
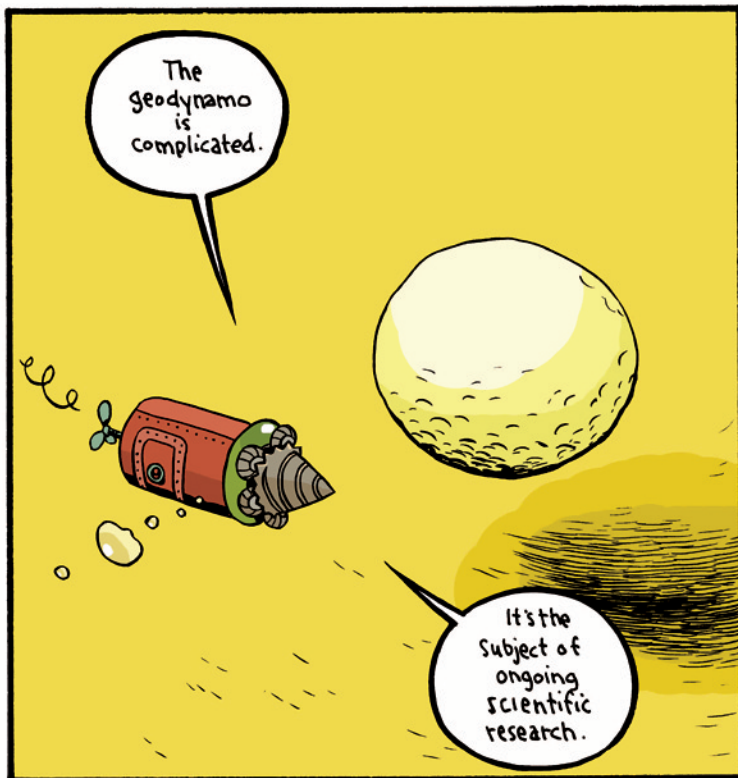




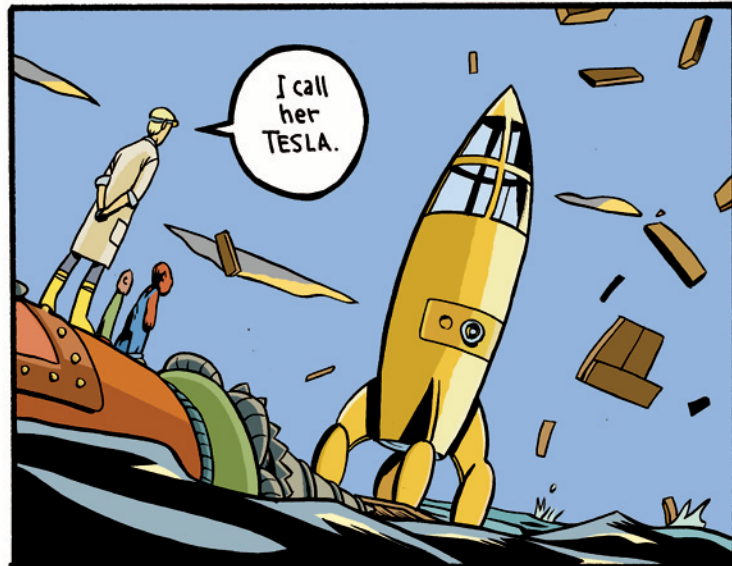
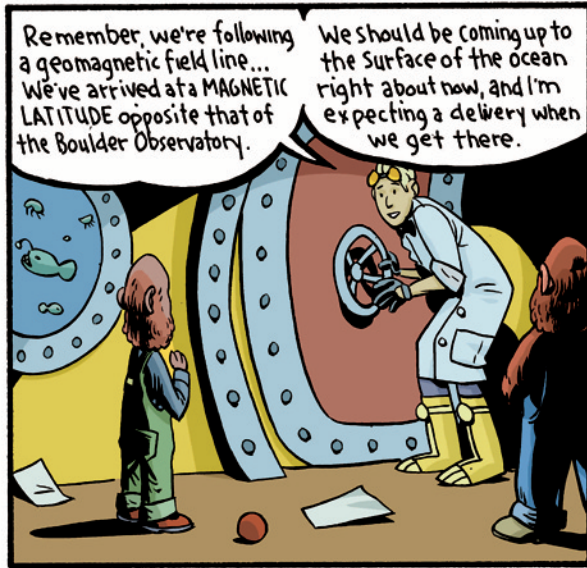




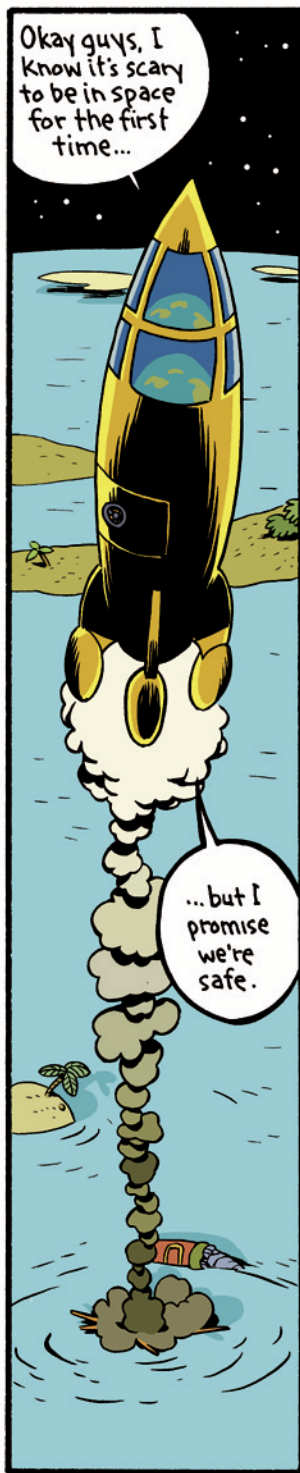












Okay guys, I know it's scary to be in space for the first time...

... but I promise we're safe.



What are you talking about, Rocket Lady? We're not scared of ANYTHING!

That's good...

... because we're passing through the Earth's ionosphere.



The IONOSPHERE?! Wh-what's THAT?

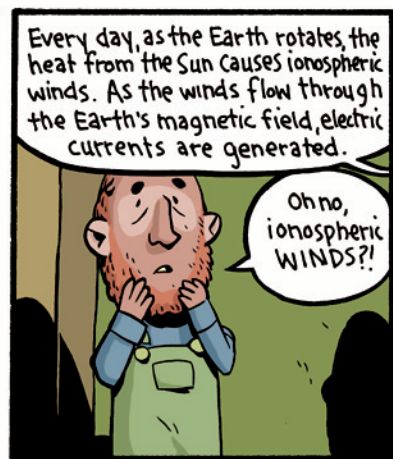
PUH! You're SCARED of EVERYTHING!



The ionosphere is the electrically conducting part of the Earth's atmosphere. It's useful!

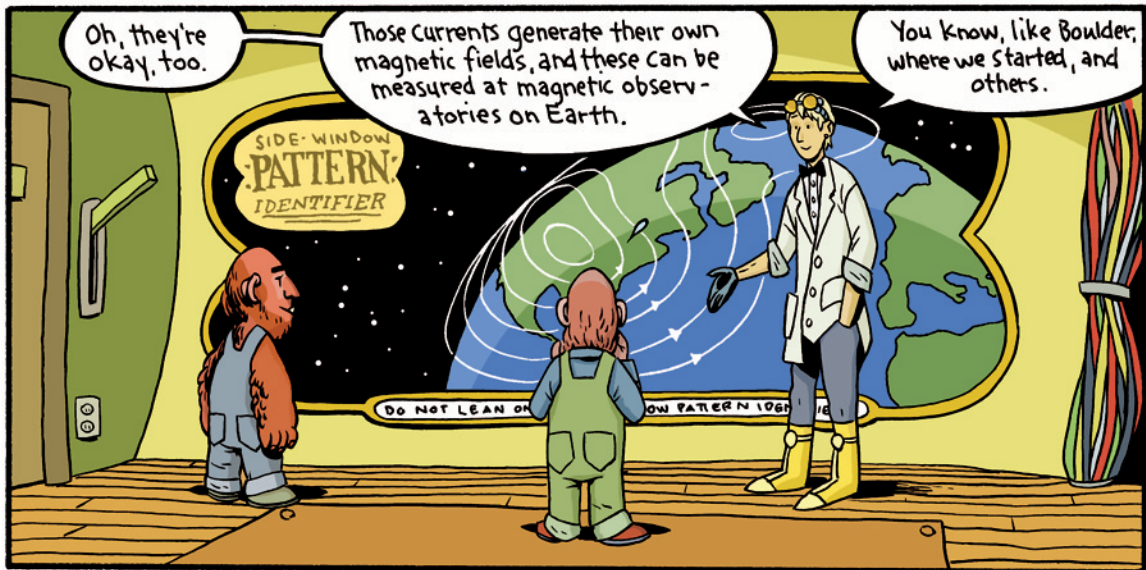
Radio waves can be bounced off the bottom of the ionosphere, allowing for communication over long distances.

Oh, that's good.



Every day, as the Earth rotates, the heat from the Sun causes ionospheric winds. As the winds flow through the Earth's magnetic field, electric currents are generated.

Oh no, ionospheric WINDS?!

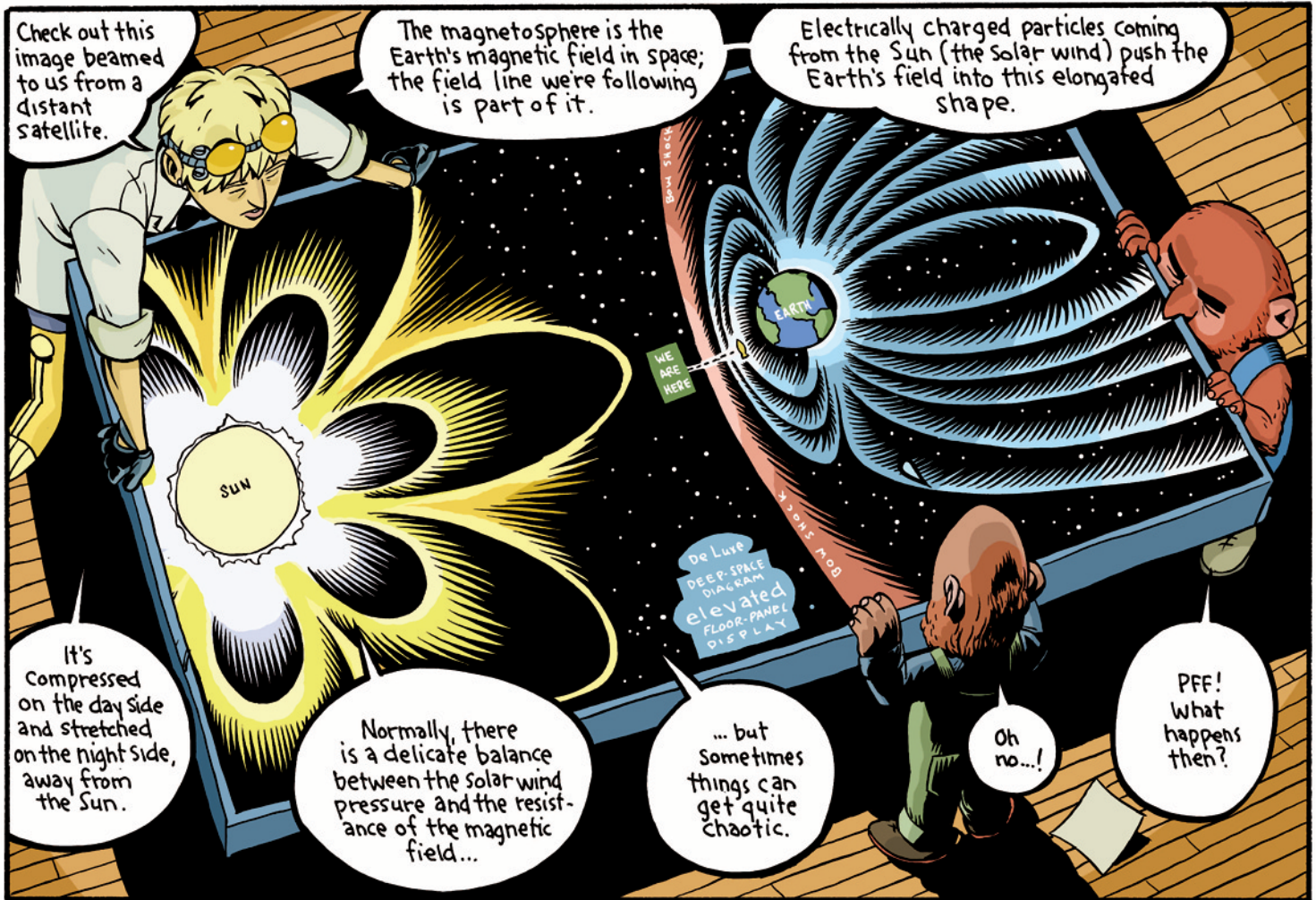
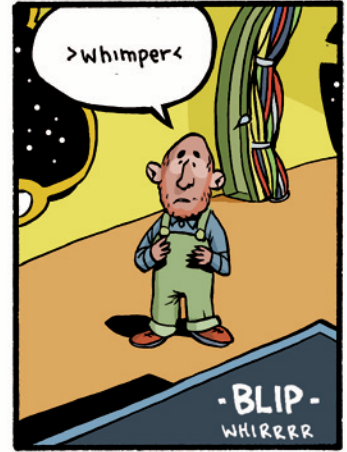


Oh, they're okay, too.

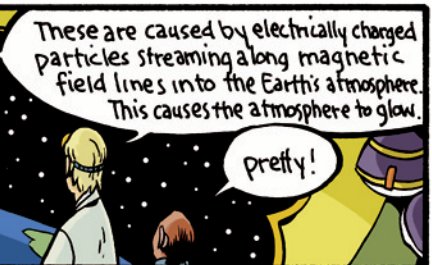
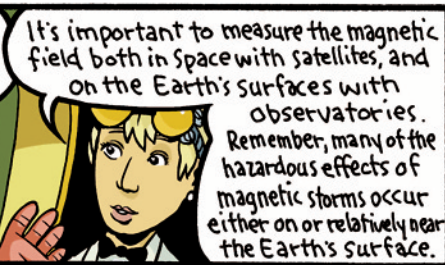
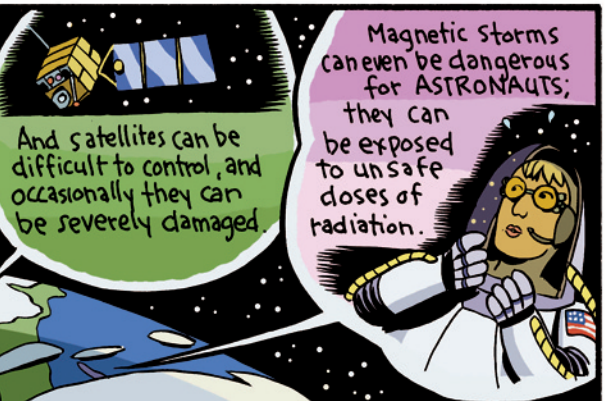
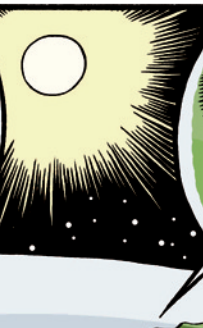
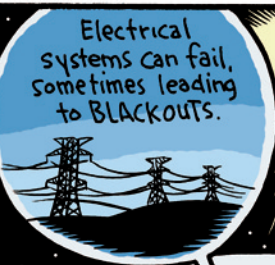
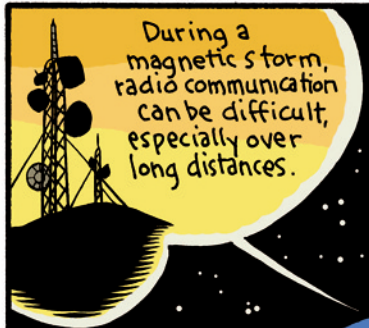
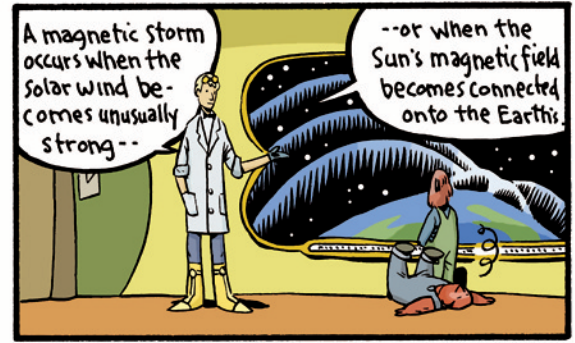
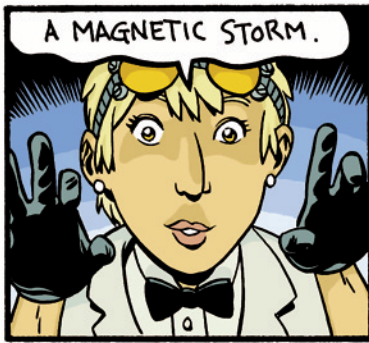
Those currents generate their own magnetic fields, and these can be measured at magnetic observatories on Earth.

You know, like Boulder, where we started, and others.

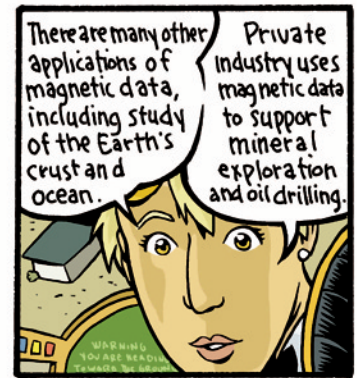
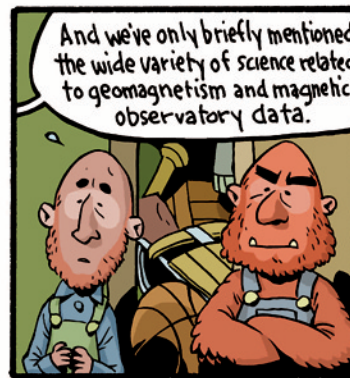
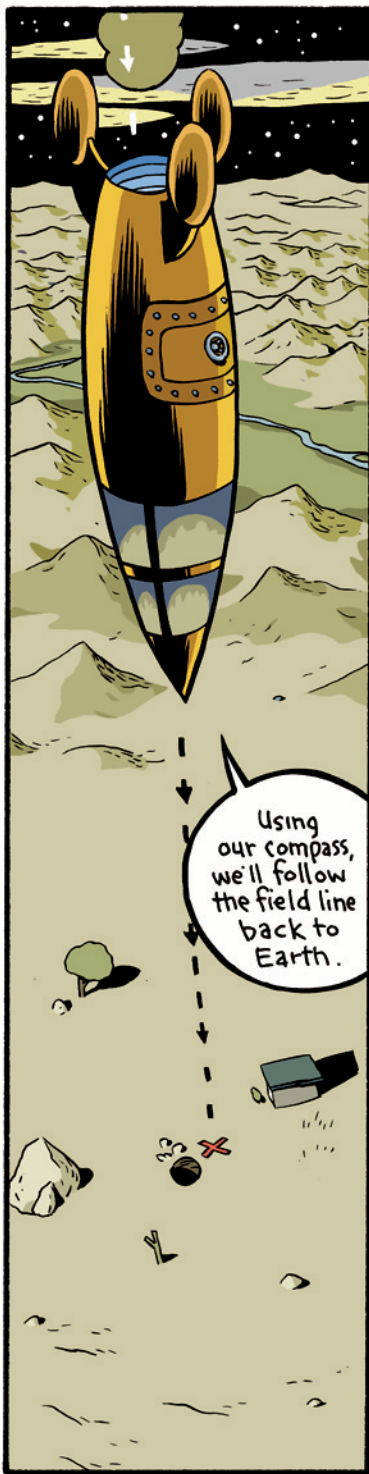












end





# G L O S S A R Y

**AURORA:** atmospheric glow, seen at high latitudes. Caused by the collision of charged particles from space with the molecules of the atmosphere. In the north, aurorae are also known as the northern lights or aurora borealis, and in the South as the southern lights or aurora australis.

**CORE of the EARTH:** the 7000-km-diameter, iron center of the Earth. The outer part of the core is liquid iron and it convects due to heat and chemical separation. The core acts like a dynamo, generating the main part of the Earth's magnetic field.

**DECLINATION:** the deviation of the direction of the horizontal part of the geomagnetic field from true north, and what is usually measured by a compass.

**DYNAMO:** something that converts the motion into electrical and magnetic energy of the Earth's core is a natural dynamo.

**INCLINATION:** the angle that the direction of the geomagnetic field makes with a horizontal plane.

**IONOSPHERE:** the electrically conducting part of the Earth's upper atmosphere, extending from about 60 km altitude and outwards into space. Tides, daytime heating, and nighttime cooling drive electric currents whose magnetic fields can be measured at magnetic observatories.

**MAGNET:** an object composed of an orderly arrangement of atoms, each of which generates its own small magnetic field and all of which, in total, give the object a magnetic field.

**MAGNETIC FIELD:** a field of force surrounding an electric current or moving electric charge, in which another electric current or moving electric charge experiences a force.

**MAGNETIC OBSERVATORY:** a ground-based facility designed specifically to accurately measure the intensity and direction of the geomagnetic field over time.

**MAGNETIC STORM:** a disturbance of the Earth's magnetic field. Sometimes lasting for several days. Caused by the Sun's solar wind and magnetic field. Magnetic storms can be monitored by magnetic observatories.

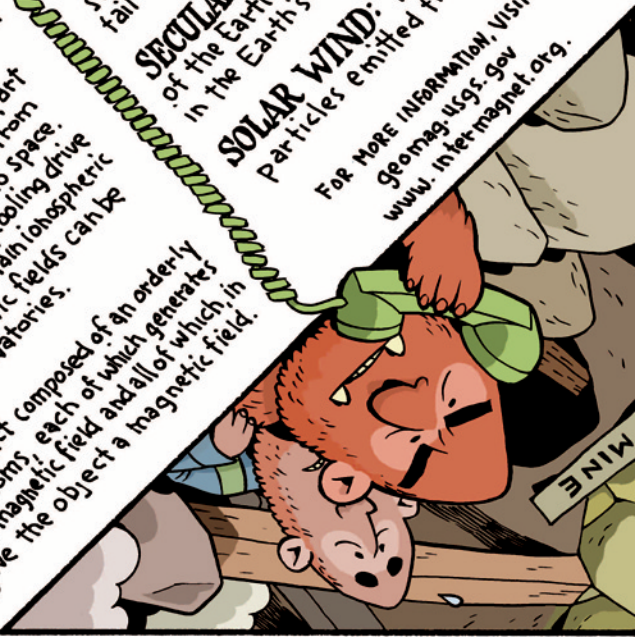
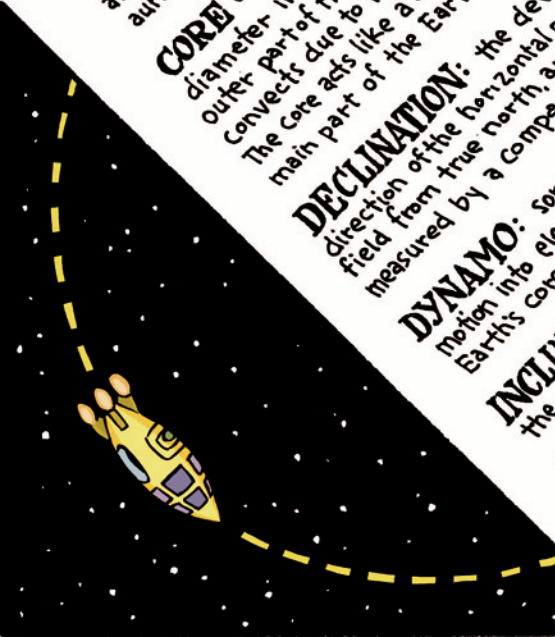
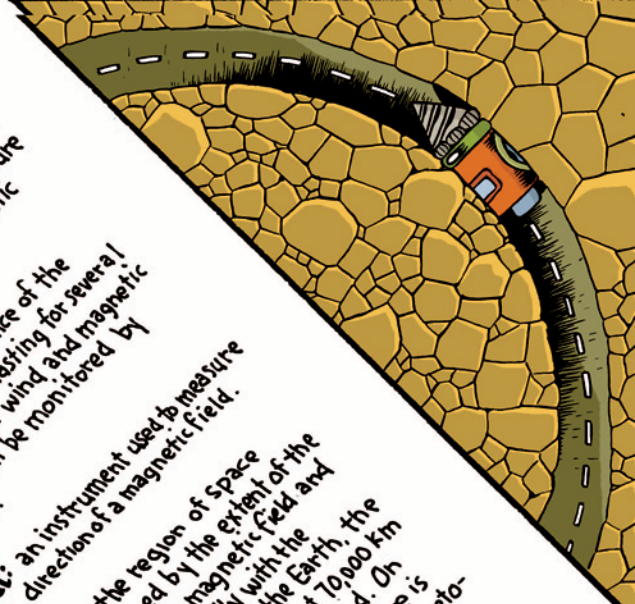
**MAGNETOMETER:** an instrument used to measure the intensity and/or direction of a magnetic field.

**MAGNETOSPHERE:** the region of space surrounding the Earth defined by the extent of the geomagnetic field. The Sun's magnetic field and solar wind interact dynamically with the magnetosphere. On the day side of the Earth, the magnetosphere only extends to about 10,000 km. On the night side, however, the magnetosphere is stretched by the solar wind, with the magnetic tail extending to millions of kilometers.

**SECULAR VARIATION:** slow drift in the shape of the Earth's magnetic field caused by motion in the Earth's liquid iron outer core.

**SOLAR WIND:** the flow of charged particles emitted from the Sun.

FOR MORE INFORMATION, VISIT:  
Geomag.USGS.gov  
www.intermagnet.org







# USGS

National Geomagnetism Program

Real-time monitoring of  
the Earth's magnetic field  
Data for research  
and practical application.

