Although the existence of mid-ocean ridges suggested that the seafloor was spreading, persuasive evidence remained elusive. Conclusive proof rested with the task of dating the mid-ocean rocks.

Unfortunately, this task confronted two problems. First, the methods used to gather mid-ocean rocks were rudimentary and unreliable. Second, rock dating instruments at the time were incapable of differentiating among the minute age-related differences in rock properties found among geologically "young" rocks.

In essence, these rocks had aged so little that they were nearly indistinguishable from one another. Existing instruments were better suited to dating rocks 1 to 2 *billion* years old. The mid-ocean ridge rocks, by contrast, were predicted to be less than 5 *million* years old.

Solutions to these two problems arose independently from several sources over a period of many years. Basic Energy Sciences research provided a crucial breakthrough in both.

Concerning the first problem, Basic Energy Sciences research produced the means for accurately dating geologically young rocks with its development of a highly sensitive instrument called a static mass spectrometer. This instrument also contributed to solving the second problem by eliminating altogether the need to recover rock samples from the mid-ocean floor. The age of these rocks could be inferred through the use of a special technique.

Before describing how this technique was applied, an appreciation of the Basic Energy Sciences contribution may be gained by understanding the basic principles of age dating and the capabilities of the static mass spectrometer. Both involve measuring the relative abundances of isotopes, that is, of the various atomic species of the same elemental family.

The principles of dating rocks and other materials by measuring the relative isotopic abundances of elements trapped within are well established. They are based on the fact that certain naturally occurring, but unstable, atomic species systematically transform themselves into elements of more stable forms (daughter products) at precisely known rates. This process, called radioactive decay, acts as an internal source of (daughter product) atom formation.

Since the decay modes are well known, the new atoms add uniquely to the abundance of one or more particular isotopes. This then skews the relative abundances among the isotopes away from their naturally occurring proportions. By measuring these proportions, figuring their variances, chemically analyzing and inferring the amount of parent atoms originally present, and knowing the rates of atom decay and new atom formation, the age of the material can be determined.

Isotopic dating of ancient rocks, those more than 1 billion years old, was routinely accomplished with available mass spectrometers using potassium as the unstable parent and argon as the daughter product. In the case of young rocks, however, nature was not so cooperative. Potassium (^{40}K) decays by one-half its original amount to argon (^{40}Ar) every 1.3 billion years. In young rocks, one-thousandth this age, precious little ^{40}Ar was produced, making reliable measurements difficult.

Existing instruments simply did not have the sensitivity to date rocks which had solidified recently in geologic time. When measuring such minute amounts, contamination by particles inside the instrument was a primary limitation to the sensitivity of a mass spectrometer.

Knowing this, Basic Energy Sciences researchers focused their efforts on building an ultraclean, self-contained instrument capable of making repetitive measurements indefinitely on the same sample, with no moving parts, once the sample had been introduced. Hence, it was given the name "static" mass spectrometer.

The concept that enabled very low contamination to be achieved was an all-glass instrument capable of securing an ultrahigh vacuum that could be completely baked at high temperature, valves and all, to drive off the contaminants. Once the sample (argon gas boiled out of the rock) was introduced, the sealed glass instrument operated continuously on this initial sample, thereby avoiding contamination from pumps and other mechanisms that are normally required to keep argon gas flowing continuously through more conventional, non-static instruments.

In the sealed glass spectrometer, atoms of the sample gas drift randomly into "ionization" chambers in the instrument where, as in conventional spectrometers, they are bombarded by an electron beam and become electrically charged, or ionized.