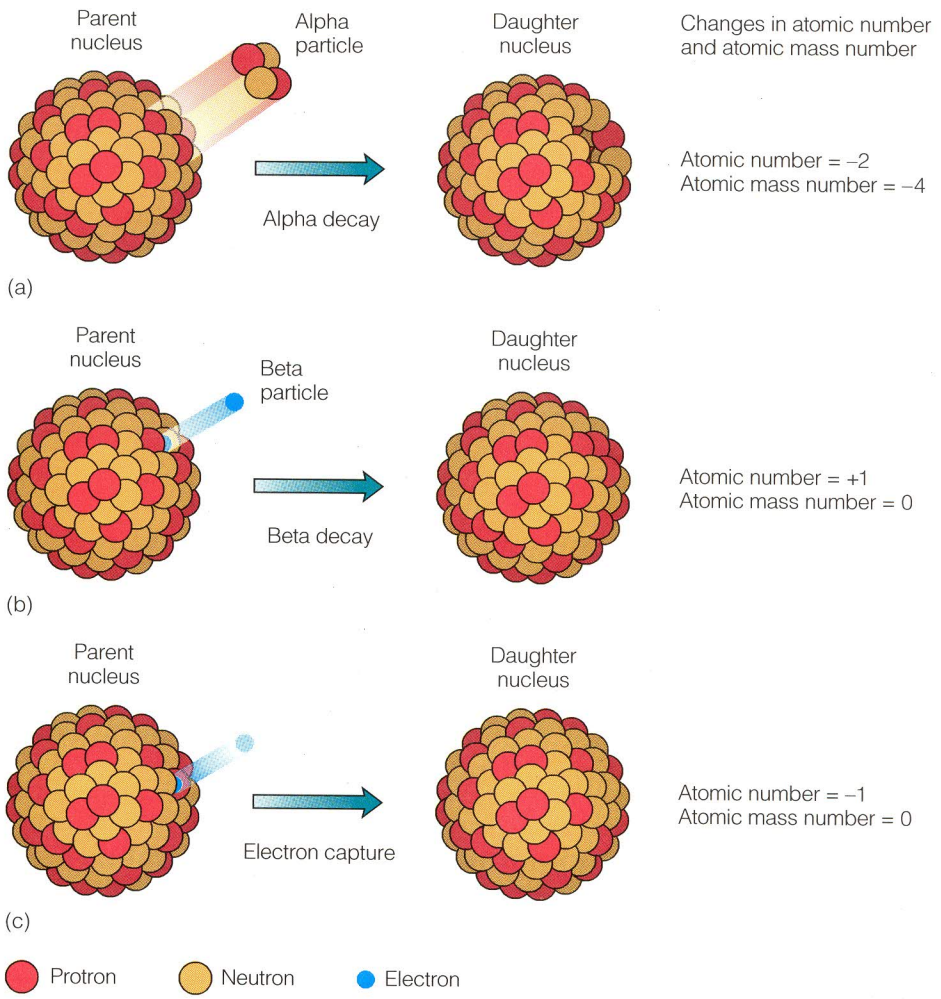

FIGURE 9-18 Three types of radioactive decay. (*a*) Alpha decay, in which an unstable parent nucleus emits two protons and two neutrons. (*b*) Beta decay, in which an electron is emitted from the nucleus. (*c*) Electron capture, in which a proton captures an electron and is thereby converted to a neutron.

into the crystal structure of certain minerals. The stable daughter atoms, however, are a different size than the radioactive parent atoms and consequently cannot fit into the crystal structure of the same mineral as the parent atoms. Therefore when the magma begins to crystallize, the mineral will contain radioactive parent atoms but no stable daughter atoms (Fig. 9-21). Thus, the time that is being measured is the time of crystallization of the mineral containing the radioactive atoms, not the time of formation of the radioactive atoms.

Except in unusual circumstances, sedimentary rocks cannot be radiometrically dated, because one would be measuring the age of a particular mineral rather than the time that it was deposited as a sedimentary particle. One of the few instances in which radiometric dates can be obtained on sedimentary rocks is when the mineral glauconite is present. Glauconite is a greenish mineral containing radioactive potassium 40, which decays to argon 40 (Table 9-1). It forms in certain marine environments as a result of chemical reactions with clay minerals during the conversion from sediments to sedimentary rock. Thus, it forms when the sedimentary rock forms, and a radiometric date indicates the time of the sedimentary rock's origin. However, because the daughter product argon is a gas, it can easily escape from a mineral. Therefore, any date obtained from glauconite, or any other mineral containing the potassium 40–argon 40 pair, must be considered a minimum age.

To obtain accurate radiometric dates, geologists must be sure that they are dealing with a closed system, meaning that neither parent nor daughter atoms have been added or removed from the system since crystallization and that the ratio between them results only from radioactive decay. Otherwise, an inaccurate date will re-