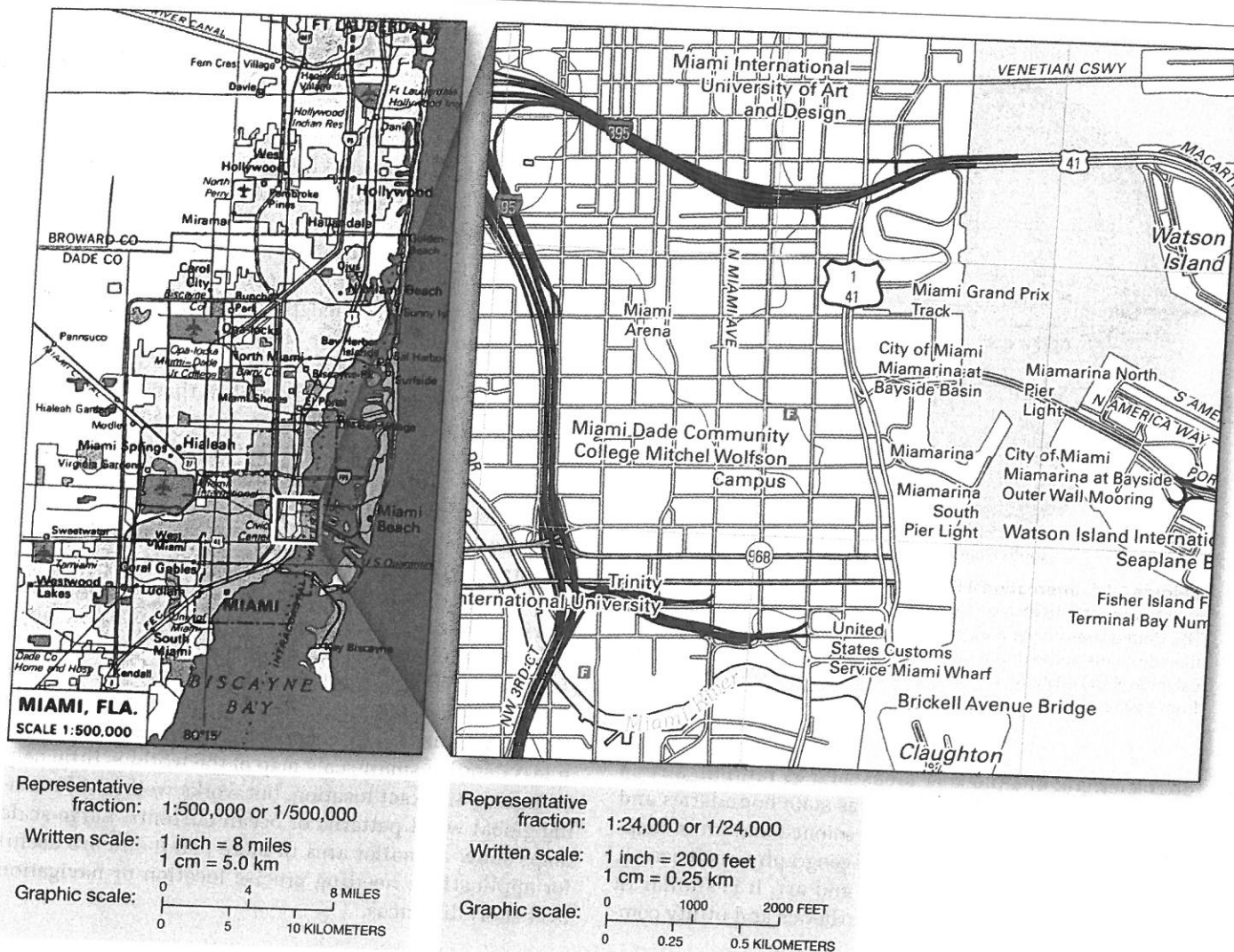




(a) Relatively small scale map of Miami area shows less detail.

(b) Relatively large scale map of the same area shows a higher level of detail.

▲**Figure 1.17 Map scale.** Examples of maps at different scales, with three common expressions of map scale—representative fraction, written scale, and graphic scale. Both maps are enlarged, so only the graphic scale is accurate. [USGS. Courtesy of University of Texas Libraries, University of Texas at Austin.]

detail, cartographers prepare large-scale *flat maps*, which are two-dimensional representations (scale models) of our three-dimensional Earth. Unfortunately, such conversion from three dimensions to two causes distortion.

A globe can provide a fairly good representation of *distance, direction, area, shape, and proximity* on Earth. A flat map distorts these properties. Therefore, in preparing a flat map, the cartographer must decide which characteristics to preserve, which to distort, and how much distortion is acceptable. To understand this problem, consider these important properties of a globe:

- Parallels always are parallel to each other, always are evenly spaced along meridians, and always decrease in length toward the poles.
- Meridians always converge at both poles and always are evenly spaced along any individual parallel.

- The distance between meridians decreases toward the poles, with the spacing between meridians at the 60th parallel equal to one-half the equatorial spacing.
- Parallels and meridians always cross each other at right angles.

The problem is that all these qualities cannot be reproduced simultaneously on a flat surface. Simply taking a globe apart and laying it flat on a table illustrates the challenge faced by cartographers (**Figure 1.18**). You can see the empty spaces that open up between the sections, or gores, of the globe. This reduction of the spherical Earth to a flat surface is a **map projection**, and no flat map projection of Earth can ever have all the features of a globe. Flat maps always possess some degree of distortion—much less for large-scale maps representing a few kilometers; much more for small-scale maps covering individual countries, continents, or the entire world.