Rosentuin ultramafic bodies. Three small deposits are situated within the Muldersdrif ultramafic body about 25 km north of Johannesburg.

Chrysotile production in Swaziland for the year 1978 was 48,000 tonnes — mainly from the Havelock mine. South African production of this fiber for 1978 was 113,000 tonnes and came from the Type II ultramafic deposits described above, as well as from Type III sedimentary deposits of the Carolina district.

*Zimbabwe*. The two principal chrysotile producing mines in Zimbabwe are located within the Mashaba and Shabani igneous complexes. The Mashaba complex occurs at the western end of the Fort Victoria greenstone belt in southern Zimbabwe. It is a layered ultramafic intrusion which includes pyroxenites and serpentinized dunites and harzburgites. The Shabani ultramafic body, located approximately 100 km west of Fort Victoria and immediately east of the Great Dyke, is a lenticular ultramafic sill and is suggested to have intruded into the Archean gneisses at the northeast margin of the Belingwe schist belt (Anhaeusser, 1976).

Small chrysotile deposits are found in the Filabusi ultramafic complexes located about 50 km west of the Shabani deposits and at the Ethyl deposit at the north end of the Great Dyke. The Great Dyke is an elongate mass of mafic and ultramafic rocks extending nearly 500 km across the Rhodesian Craton. It is not a true dike but rather the remains of four lopolithic intrusions. Chrysotile asbestos is found in the vicinity of faults where serpentinization apparently was promoted.

In 1978 the Zimbabwean chrysotile production was 210,000 tonnes, of which about 60 percent came from the Shabani and 35 percent from the Mashaba deposits.

Type III deposits

Commercially less important, yet geologically very interesting chrysotile deposits occur in serpentinized limestones; two notable localities are in the Globe area of central Arizona and in the Carolina area of the Transvaal.

The Arizona asbestos-bearing strata occur in the Precambrian Mescal limestone formations of the Apache Group, where diabase sills a few centimeters to a few meters thick have intruded. The commercial asbestos is developed by replacement of the limestones by serpentine, usually occurring within 40 meters of the diabase intrusion (Bateman, 1923; Stewart, 196: Although only about 50,000 tonnes of chrysotile asbestos has been produced from Arizona from the time the deposits were opened early in this century to the present, the fiber is of very high quality and much soug after for applications in advanced technology.

An occurrence very similar to that in Arizona is found in the Transvaal Basin, where dikes and sills of diabase have intruded and altered the Malmani Dolomite. The principal asbestos deposits are located in eastern Transvaal west of Barberton Mountain Land and east of Carolina. The sills commonly produced a metamorphosed assemblage in the dolomite extending for a meter or more above the upper chilled contacts with the diabase. The controls on serpentine mineralization involve dedolomitization to calcite to furnish magnesium, solution of chert to furnish silica, and the presence of the diabase sill to furnish $H_2O$ and heat (Anhaeusser, 1976). Fiber is not developed in chert-free dolomite but is seen replacing chert where present immediately above the sill.

As with the formation of amphibole asbestos discussed previously, it appears that in addition to the necessary chemical controls, a stress environment resulting from folding, faulting, or differential heating is required to promote the growth of chrysotile fiber. Anhaeusser (1976) suggests that the dominant regional controlling factor for asbestos development is folding.

## HEALTH HAZARDS OF ASBESTOS

Diseases related to asbestos exposure

There are three principal diseases which are related to exposure to one or more of the commercial asbestos minerals. These are: (1) lung cancer, which includes cancer of the trachea, bronchus, and lung proper; (2) mesothelioma, a cancer of the pleural and peritoneal membranes which invest the lung and abdominal cavities, respectively; and (3) asbestosis, a diffuse interstitial fibrosis of the lung tissue often leading after long exposure to severe loss of lung function and respiratory failure. The lung cancer of asbestos workers is also associated with cigarette smoking, which leads to considerable difficulty in assigning relative risks of asbestos exposure to smokers. Mesothelioma, a disease which is