for ores and minerals with low-grade impurities or complex mineral composition. Fuels research includes evaluation of fossil fuels and development of refining methods for the low-grade, high-sulphur petroleum of the Athabasca oil sands. Research is also being conducted to improve burning qualities of coal. In the related area of the extraction of metal by heat, research is concentrated on development of a shaft electric furnace for smelting iron ore. In mineral sciences, the department carries out physical, chemical, crystallographic and magnetic studies to determine characteristics important to extraction and processing methods. It also produces standard reference ores and metals needed by mining and metallurgical companies. In metals research, in addition to improving techniques for metal forming, attention is focused on ensuring structural soundness of metal pipelines for the Arctic. Other programs are directed toward reduction of pollution and conversion of mineral waste into useful materials such as fillers and ceramics.

The department's geological survey maps and studies the geology of Canada. A principal aim is to ascertain available mineral and energy resource potential. The survey estimates the amount and distribution of mineral and fuel resources by providing a systematic geological framework, by defining settings favourable to mineral and fuel occurrences and by appraising foreign resources. The department is concerned with use and conservation of resources and preservation of the environment. The survey provides information on land resources and terrain performance derived from studies of earth and rock materials, land forms and associated dynamic processes.

The department also carries out geophysical work of interest to the mineral industry. It collects and publishes maps and charts on the geomagnetic field in Canada. Most of this information is obtained from airborne geomagnetic surveys which have ranged over all of Canada and as far as Scandinavia. The branch maintains a network of permanent magnetic observatories. It also operates a network of seismic stations to study the earth's interior and assess seismic risk. In gravity research, another means of studying the composition of the earth's crust, the department maps variations in gravity on a regional basis including the Arctic and the continental shelves. Geothermal studies in mines and deep boreholes provide information to the mineral industry on underground thermal conditions, including permafrost.

The department has completed topographical mapping of the country at the medium scale of 1:250,000, or about 2.5 km to the centimetre. About 52% of the larger-scale mapping at 1:50,000 of more settled areas and those of greater economic importance has been completed. Also available for selected areas are maps at other scales. Another department function is establishment of a basic network of survey control points across Canada that provide precise figures of latitude, longitude and elevation above sea level. Topographic maps, multicoloured maps for other government agencies, aeronautical charts and the National Atlas of Canada are also produced. The air photo library has on file over 4 million aerial photographs of Canada, both black and white and colour, taken over the last half-century from aircraft and more recently from space satellites.

The department also controls, under the Canada Explosives Act, the manufacture, authorization, storage, sale, importation and transportation by road of explosives. It is also responsible for research programs and policies in the field of non-renewable resources. It conducts fundamental and applied resource-engineering-economic research and field investigation into non-renewable resource problems on a total industry basis, in a regional, national and international context. Activities include the publication of reports; regional studies of the mineral economy in Canada; assessment of mineral projects for which federal support has been requested; resource and reserve studies in a number of mineral commodities; and the safeguarding of Canadian mineral interests through participation in the work of international agencies. The sector publishes extensively and maintains a listing of about 16,000 mineral showings and deposits in Canada that may be consulted by the public.

A policy-making group appraises trends in oil and gas exploration and production, transportation, processing and marketing in Canada and abroad, and provides information to federal government agencies, industry and the public on oil and gas developments. In the field of uranium, it co-ordinates matters in the areas of