# CHAPTER 1 INTRODUCTION

## PURPOSE

In the southern end of the Intermontane Belt, widespread stratified rocks of Tertiary age locally contain coal, zeolites, clays and diatomaceous earth. The presence of past producers of bentonite (Showing B6, near Princeton) and perlite (Frenier mine, P2, near Gang Ranch), existing producers of ceramic and refractory clays (Sumas Mountain) and diatomaceous earth (Red Lake, D2, near Kamloops), and potential producers of kaolinite (Lang Bay) and zeolites (showings Z4 to Z7, near Princeton) suggest that there is a potential for economically viable industrial mineral deposits in the Tertiary rocks.

The main objective of this investigation was to assess the industrial mineral potential of the Tertiary stratified rocks between Princeton and Gang Ranch, southern British Columbia. This was accomplished by the geological mapping of several areas of Tertiary rocks to locate known and find new occurrences of industrial minerals, and to determine their geological setting. The mapping yielded regional correlations of Tertiary rocks and led to some understanding of the parameters necessary for the development of several industrial minerals. By the use of x-ray diffraction, wholerock and exchangeable cation analyses, and other tests, some of the parameters of many of the industrial minerals showings were quantified and compared to each other and to the products of operating mines in the western United States.

## LOCATION AND ACCESS

All of the areas investigated contain extensive Tertiary rocks in which sediments are an important if not the dominant component of the stratigraphy (Figure 1). From southeast to northwest these areas are:

- Princeton to Tulameen
- Merritt to Quilchena to Guichon
- Bonaparte to Deadman rivers
- Hat Creek
- Fraser River: Lillooet to Gang Ranch

The areas lie south of latitude 52N and, with the exception of parts of the area along the Fraser River, they straddle major highways and railways. Access is easy as secondary and logging roads, in differing states of disuse, penetrate all the areas except for parts of the west side of the Fraser River. A rolling topography ranging from 600 to 1400 metres (2000 to 4500 feet) in elevation typically develops on the Tertiary rocks; only along the Fraser River are the slopes steep and descend to less than 300 metres (1000 feet).

Poor bedrock exposures offset the advantages of the gentle topography and easy access. Everywhere the Tertiary volcanic rocks form better outcrops than the sedimentary rocks. Of the sediment-dominated areas, the 5% outcrop of the Princeton to Tulameen area is the best, followed by Merritt and vicinity, and ending with the less than 0.25% exposure in upper Hat Creek valley. Drilling to assess the coal resources of the Eocene rocks augments the surface information and, in upper Hat Creek valley, the geological interpretation also relies on geophysical surveys and trenching. Where bentonite is part of the sedimentary succession, the possibility of large slide blocks, such as those at Hat Creek, is an additional complexity. Exposures of Miocene sediments are very poor along the Fraser River and the Bonaparte and Deadman rivers and tributaries. The few outcrops are restricted to rare road and stream cuts. As a result of the near absence of outcrop, the presence of sediment chips in the soil on steep slopes and in upturned tree roots must be used to map much of the distribution of the Miocene sediments.

Because most of the industrial minerals found in Tertiary rocks, such as kaolinite, bentonite and diatomaceous earth, are associated with sediments and form exposures that slump easily, they are preferentially covered by overburden. Drill logs do not augment the poor surface information. With the exception of the Hat Creek area, the logs of holes drilled for coal exploration usually do not record the presence of industrial minerals. Experience in the Princeton area indicates that drillcore of the zeolitized tuff has not been recognized. Except for a few holes near Chartrand and Enright lakes close to Deadman River, drilling has not penetrated Miocene sediments.

In contrast to the sediments that host the forementioned industrial minerals, zeolitized tuff preferentially outcrops. However, because the presence of even significant amounts of zeolites cannot be determined by eye, such zeolite occurrences, even those on major highways such as Highway 3 south of Princeton, have been overlooked for decades.

Any assessment of the potential of these industrial minerals without trenching or drilling must be regarded as preliminary and incomplete.

## GEOLOGICAL WORK

The results of geological mapping and investigations undertaken by the author in 1977 and 1978 for Canadian Occidental Petroleum Ltd. (Read, 1977, 1978) are included in this report. In the Princeton area, this work led to the discovery of all the major occurrences of zeolites. Starting in 1986 and continuing for parts of the summers and falls of four years, for a total field time of 8 months, the author geo-

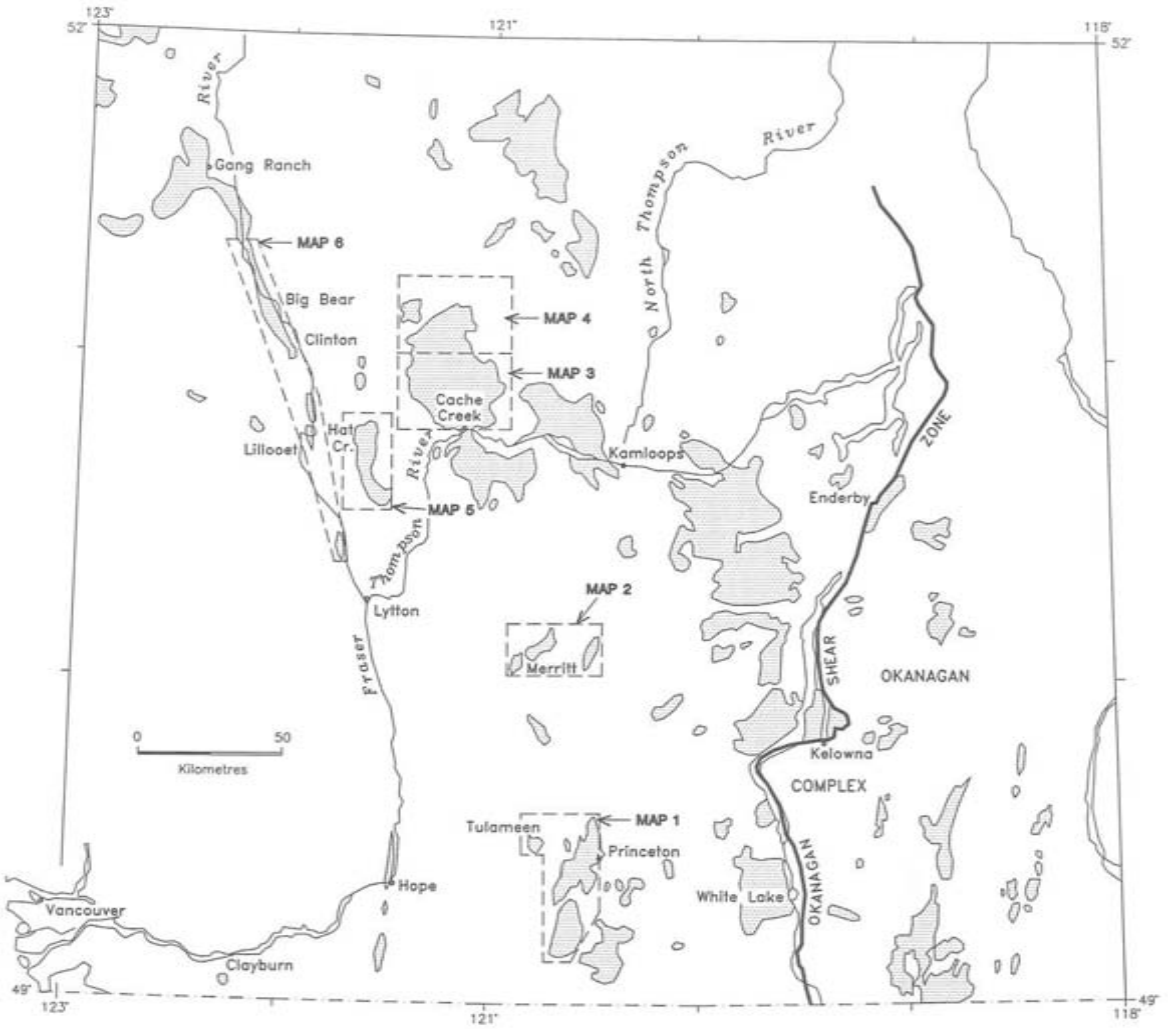


Figure 1.1. Map of southwestern British Columbia showing Eocene rocks (shaded), Okanagan Valley fault, Okanagan Complex and the location of areas mapped in this investigation.

logically mapped the Princeton to Tulameen and upper Hat Creek valley areas and parts of the Merritt basin at 1:25 000 scale, and the remainder of the areas at 1:50 000 (Read 1987a, 1987b, 1988a, 1988b, 1988c, 1988d, 1988e, 1989a, 1989b, 1990a). This work was done under contract to the British Columbia Ministry of Energy, Mines and Petroleum Resources as part of the 1985-1990 Mineral Development Agreement between Canada and British Columbia.

A total of 726 x-ray diffractograms, 295 exchangeable cation analyses and cation exchange capacity measurements, and 8 perlite expansion and pyrometric cone tests quantify the mineralogical, chemical and physical characteristics of the samples of industrial minerals collected during the fieldwork. In addition, 143 palynologic, 4 micropaleontologic, and 12 radiometric age determinations, all unpublished, have been combined with the new geological mapping and form the basis for the modification of earlier mapping and interpretations.

These geological investigations provided a unique opportunity for one person to map and study the major Eocene and Miocene sedimentary accumulations in southern British Columbia west of the metamorphic core complexes. In addition to 63 new occurrences of industrial minerals discovered during the investigations, contributions have been made to the Eocene and Miocene regional stratigraphy and depositional setting (Read, 1990b). This report joins the more than twenty publications issued by the British Columbia Ministry of Energy, Mines and Petroleum Resources on the broad spectrum of industrial minerals known in British Columbia, but differs from most in the strong emphasis on the regional geology of the areas of industrial mineral occurrences. Open File maps (1987-19, 1988-15, 1988-29, 1988-30, 1989-21, 1989-27, and 1990-23) are an integral part of this study and should be referred to by the reader of this report.

## ACKNOWLEDGMENTS

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From the Department of Geological Sciences at The University of British Columbia, G.E. Rouse made most of the palynological determinations, which permitted a new interpretation for Hat Creek, and W.H. Mathews shared his knowledge of Cenozoic stratigraphy and structure in British Columbia and provided unpublished and new radiometric age determinations.

P.T. McCullough of B.C. Hydro not only shared his knowledge of Hat Creek and critically reviewed that portion of the study, but also provided boxfuls of geological data from Hat Creek, obtained the permission to publish about 70 palynology determinations made for B.C. Hydro, and arranged access to the core for further sampling.

Most of the fieldwork was done on private or leased lands and ranchers, too numerous to name, not only permitted access, but on many an occasion served a meal and provided a roof for the weary.