Ancient TL

www.ancienttl.org · ISSN: 2693-0935

Lian, O., 1997. *Thesis Abstract: Quaternary geology of the Fraser Valley area, Big Bar Creek to Pavilion, Southcentral British Columbia.* Ancient TL 15(2): 46-47.
https://doi.org/10.26034/la.atl.1997.280

Thesis Abstracts

Thesis title : Quaternary geology of the Fraser Valley area, Big Bar Creek to Pavilion, Southcentral British Columbia

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Submitted to : the Faculty of Graduate Studies, The University of Western Ontario, London, Ontario for the degree of Doctor of Philosophy, March, 1997.

A detailed glacial geological investigation of late Wisconsinan ($\delta^{18}O$ stage 2) till, and associated sediments, in conjunction with a lithostratigraphic study, was conducted in south-central British Columbia between Pavilion and Big Bar Creek, near the centre of the Cordilleran Ice Sheet. In addition, the utility of optical dating using 1.4 eV excitation was tested on sediments from depositional environments most common to the region.

Till was characterised by the strength and shape of pebble fabric, the orientation of stoss-lee features on stones, the shape of stones, the nature and orientation of surface striae, and by nature of structures in the till matrix and in the substrate. It was generally found that on the mountain plateaux, and within a mountain valley, that sub glacial deposition generally involved a series of superimposed processes and till rheologies.

Ice that arrived first into this region appears to have been cold-based, and it may have been coupled to the substrate. Evidence of this includes glacially-fractured bedrock and sediment. However, it is clear that a glaciation proceeded warm-based conditions ensued and motion at the ice-substrate interface resulted in the deposition of lodgement till. There is also evidence from several sites that indicates that as the till thickened, and as pore-water increased, the till experienced viscous deformation. During this time till would have moved (flowed) as a thick slurry, thus contributing to the forward motion of the ice. In places there is evidence that periodic (?) drainage resulted in brittle deformation. Ice-flow indicators show that flow direction was generally controlled by topography.

The existence of a deformable bed implies that ice in this region moved rapidly, possible streamed, over plateaux and through mountain valleys. If these conditions were widespread, then the centre of Cordilleran Ice Sheet probably consisted of localised accumulation zones and divides, with ice issuing from them. This conjecture is supported by previous studies of regional ice-flow patterns.

Evidence of the last (Fraser) and penultimate (Okanagan Centre) glaciations have been found in the Fraser Valley, and evidence of an older glaciation has been found near Pavilion. In the Fraser Valley, Okanagan Centre Drift occurs at the base of the valley fill, which in turn indicated complete incision during the last interglaciation ($\delta^{18}O$ stage 5).

Ice flow on the plateaux and in a mountain valleys, between Pavilion and Jesmond, appears to have been to the north. This together with data from previous studies suggests that a major ice divide may have occurred between 50°50.4'N and 50°40.5'N.

Optical dating studies were performed on poorly-bleached glaciolacustrine sediments from the Fraser Valley fill. The results indicate that the apparent optical ages can be valuable in establishing age-ranges, at least at the $d^{18}O$ time scale. Holocene-aged loess from the Fraser Plateau, adjacent to the eastern edge of the Marble Range, yielded incorrect and inconsistent optical ages, and further study indicated that some of the sediment grains had remained shielded from sunlight during transport; it is thought that this effect was due to the presence of carbonate-cemented grain clusters. On the other hand, loess from the western edge of the Fraser Valley produced optical ages which were in excellent agreement with the known age of the deposit.

Thesis title: The development of luminescence methods to measure thermal exposure in lithic and ceramic materials

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Submitted to : the University of Glasgow for the degree of Doctor of Philosophy, September 1996.

Thermometric analyses provide extremely useful information about heated archaeological materials and fire-damaged modern structures. A number of non-luminescence thermometry methods have been developed for analysing pottery firing temperatures. However, many of these methods are limited in analysis range and accuracy, or are time consuming, expensive and complex. In addition to these techniques there are a number of thermoluminescence (TL) thermometry methods but they are also limited in analysis range and the majority have been developed for specific thermometry problems. The aim of this study was to investigate the use of TL and photostimulated luminescence (PSL) methods to develop rapid, precise, inexpensive thermometry techniques that were applicable to a wide range of thermal events and materials from archaeological and modern contexts.

A basic theoretical treatment of luminescence kinetics in silicate systems was undertaken to develop an understanding of TL glow curve alterations arising from thermal exposure. Kinetic studies showed that a combination of temperature and duration parameters is expected for single trap systems. Kinetic theory was developed to produce a new first order multi-trap system which provides a theoretical means of separating temperature and time components, which may be applicable to synthetic phosphors. Additionally heat transfer solutions were investigated to examine the temperature distribution in heated solids and TL instrumentation.

Isothermal annealing experiments on IAEA F-1 potassium feldspar showed a highly precise progressive thermal exposure monitor, whereby the position of the first rise of an annealed TL glow curve is characterised by a linear increase in temperature and a logarithmic increase in time. First order kinetic simulations and initial rise measurements demonstrated a continuous linear distribution of traps in IAEA F-1 feldspar. Using a high temperature TL system (maximum temperature 700°C) the progressive thermometry method was successfully applied to separated feldspar minerals and polymineral samples from archaeological (ceramics, burnt stones and hearthstones) and modern (fire damaged concrete) materials.

PSL excitation spectroscopy showed potential thermometric behaviour but for some samples the sensitivity of the system was too low. Pulsed infra-red PSL showed there may be a limited trap distribution over which a small range of thermal exposures will operate. Combined TL/PSL measurements showed it may be possible to separate temperature and time parameters.

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