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Technical Program

SS5: 3-D mapping applications for regional geological studies

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Room / Salle: **Exhibit Hall**
Date: **5/28/2008**
Time: **4:30 PM**
Presenter: **Xiaogang Ma**

Application of 3D GIS to improve the effect of kriging method in ore reserves estimation and mining

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Kriging method is closely related with spatial parameters distribution and has been used in ore reserves calculation, while the 3D GIS has excellent ability in geological modelling and virtual reality. The result of ore reserves estimation can go beyond the concept of 2D quantity statistics if we realize it with 3D ore body model and block model. A handling procedure has been realized for borehole and adit intervals composition, ore body outline figuring and ore body formation. In the latter work, block model is restricted by ore body model, and the attributes of each block cell, such as the ore grade, volume and coordinates, are quantified. After kriging interpolation, the attribute of the cell can be revealed by appointed legend color. Statistical reports of ore grade, reserves and distribution can also be generated with the result of block model. With 3D GIS as the operation platform, ore body model and block model can be added into the overlapped model system with other models, *i.e.* regional environment, open pit design and underground mining design, *etc.* Since they are in a uniform coordinates system and appeared as map layers, some are fixed information while the others are dynamic, appointed layers can be distilled out to form new models for specific applications, such as periodic mining design and natural situation analysis. The 3D ore body model and block model not only enhance the appearance of ore reserves estimation result, but also act as the joint point between mineral exploration and mining design when they are merged into the overlapped model system.

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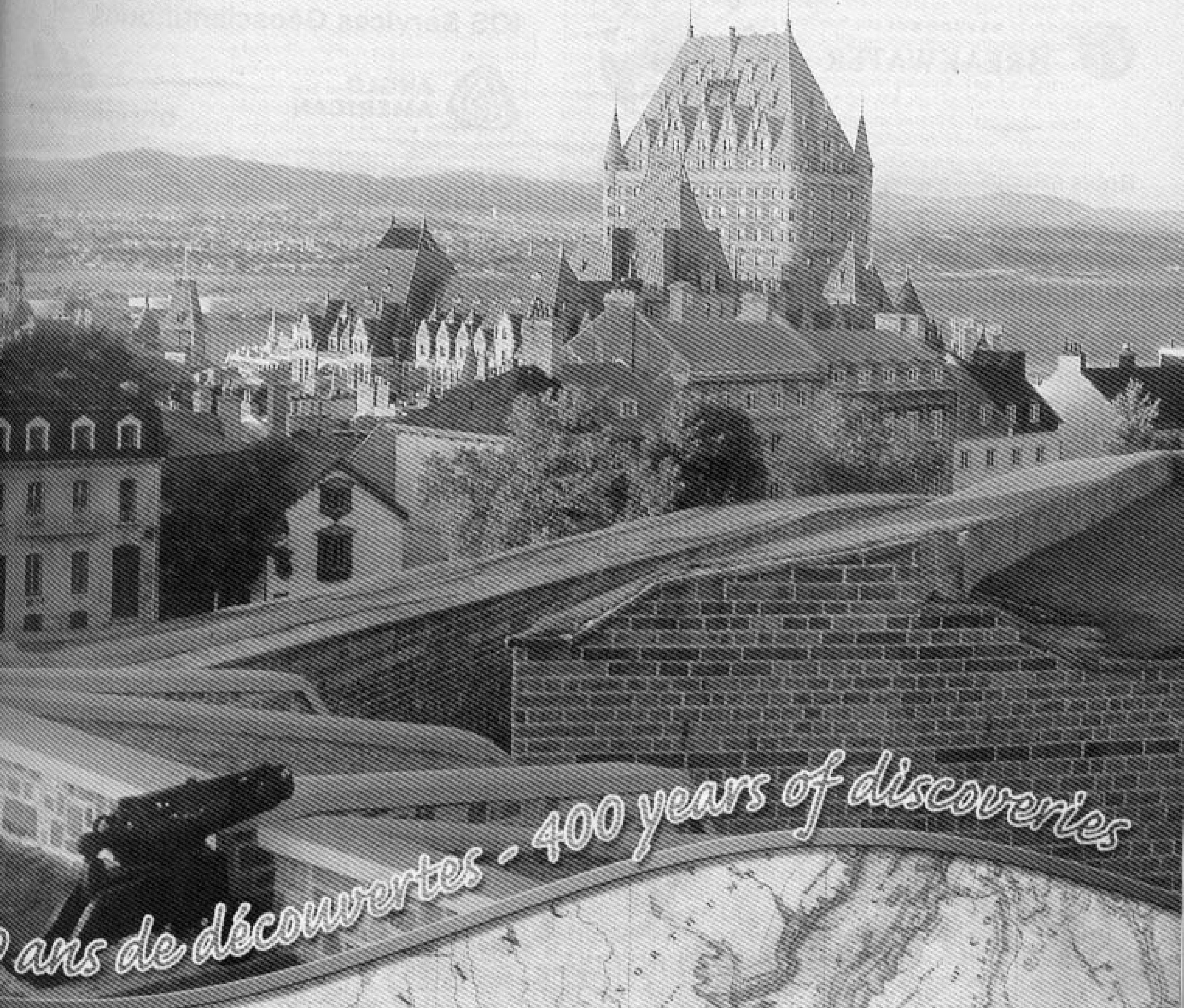

SUMÉS . ABSTRACTS

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geneity and gravitational instability induced by plate collisions may trigger intensive intraplate deformation and even orogenesis. The time interval between the plate integration and the orogenic reactivation is decided by the levels of the lithospheric instability and the thermal disturbance from the Earth's depths. Distinguished from the orogenesis at the plate boundaries, the intraplate orogenesis lacks the processes of plate subduction and collision. The intraplate orogen has relatively simple history commonly initiated by lithospheric delamination and characterized by vertical accretion of the orogenic crust. The intraplate orogenesis will be completed by the other delamination event or the formation of a new lithosphere with light gravitational instability. Therefore, the intraplate orogenesis develops commonly along a ancient orogen. The feature of lower matured lithospheric structure in an ancient orogenic belt is not only one of the primary factors causing the lithospheric gravitational instability. A lower matured lithosphere contains huge volatiles and ore-forming elements and hence has higher potential ability to form ore deposits. Metallogenesis in an intraplate orogen is dependent to if sudden releasing ore-bearing fluids from various depths of the lithosphere – asthenosphere system. Consequently, the metallogenesis occurs mainly in the initial stage and the post-orogenic extension stage. ***(SY2; 26/05/2008; P7)***

THE OCCURRENCE OF TETRAHEDRALLY COORDINATED Al AND B IN TOURMALINE: A ^{11}B AND ^{27}Al MAS NMR STUDY

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Considerable debate has surrounded the occurrence of tetrahedrally coordinated Al and B at the *T*-site in tourmaline. Although previously documented in several tourmalines, the frequency of these substitutions in Nature, as well as the extent to which they occur in the tourmaline structure, is not known. Using ^{11}B and ^{27}Al MAS NMR (Magic-Angle-Spinning Nuclear Magnetic Resonance) spectroscopy, we have investigated the presence of B and Al at the *T*-site in fifty inclusion-free tourmalines of low transition-metal content and different species (elbaite, liddicoatite, dravite, uvite, olenite and magnesio-foitite) from different localities worldwide. Chemical shifts of $^{[4]}$B and $^{[3]}$B in ^{11}B spectra, and $^{[4]}$Al and $^{[6]}$Al in ^{27}Al spectra, are well-resolved with only minimal overlap, allowing detection of even small amounts of *T*-site constituents. In the observed spectra, $^{[4]}$B and $^{[3]}$B peaks are located at 0 and ~18 ppm, respectively, with the greatest intensity corresponding to $^{[3]}$B (= 3 *apfu*). In ^{27}Al spectra, $^{[4]}$Al and $^{[6]}$Al bands are located at 50-75 and 0 ppm, respectively, with the greater intensity corresponding to $^{[6]}$Al. However, inadequate resolution between ^{Y}Al and ^{Z}Al precludes resolution of these two bands. Simulation of ^{11}B MAS NMR spectra shows that tetrahedrally and trigonally coordinated B can be readily distinguished and that $^{[4]}$B/$^{[3]}$B ratios of 1-3% are common in many tourmalines. ^{27}Al MAS NMR spectra show that Al is also a common constituent of the *T*-site in tourmalines. Determination of the $^{[4]}$Al/$^{[6]}$Al ratios by peak area integration commonly shows values of 1-3%. Furthermore, the chemical shift of the ^{27}Al tetrahedral peak is sensitive to local order at the adjacent *Y* and Z octahedra, where $^{[4]}$Al-^{Y}Mg$_3$ and $^{[4]}$Al-^{Y}(Al,Li)$_3$ arrangements result in bands located at ~65 and ~75 ppm, respectively. Both ^{11}B MAS NMR and ^{27}Al MAS NMR spectra show dramatic signal quenching as a function of transition-metal content (*i.e.*, $Mn^{2+} + Fe^{2+} + Ti^{4+} = 0.01 - 0.1$ *apfu*) in the host tourmaline. In ^{11}B spectra, significant broadening and loss of intensity of the $^{[3]}$B signal ultimately obscures the signal corresponding to $^{[4]}$B, dramatically increasing the limit of detection of $^{[4]}$B in tourmaline. ^{27}Al spectra are significantly more sensitive to this effect. Our results clearly show that all combinations of Si, Al and B: $T = (Al, Si)_6$, $T = (B, Si)_6$, $T = (Al, B, Si)_6$, and $T = Si_6$ *apfu*, are common in natural tourmalines. ***(SS26; 26/05/2008; 8:50)***

APPLICATION OF 3D GIS TO IMPROVE THE EFFECT OF KRIGING METHOD IN ORE RESERVES ESTIMATION AND MINING

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THE EFFECTS OF VARIABLE QUALITY DATA ON THE ACCURACY OF 3-DIMENSIONAL SUBSURFACE MODELS FOR THE McMASTER CAMPUS, HAMILTON, ONTARIO

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As the demand for 3-dimensional subsurface models has been steadily increasing over the past few years, so too has the dependency on large, readily available digital databases, such as the Ontario waterwell database, in order to produce models in relatively short time frames. However, the most common problem with relying on waterwell data as the primary (and in some studies the only) data source is the variable quality of the input data. Both the accuracy and reliability of model outputs are constrained by the quality of input data. This presentation will show how the 3-dimensional model output of the McMaster Campus subsurface varied with the quality of the input data and will offer a new method for integrating data from various sources while compensating for the inadequacies of the lesser quality data sets.

Boreholes records were obtained from construction and engineering reports, the Hamilton urban geology database, and the Ontario waterwell databases. The quality of the borehole records was determined based on the level of detail in the soil type descriptions that accompanied the borehole logs and also on the degree of correlation with neighboring wells. The higher quality borehole records came from soil reports and construction reports in which the depth and characteristics of the underlying sediment were the focus of the investigation. The lower quality records were obtained from the large digital waterwell databases which typically provide very general soil classifications with little or no accompanying description. For these records the primary focus is on finding water rather than on accurately logging the subsurface sediments. In many situations it may be appropriate to integrate both high and low quality data into a single database but this may cause a significant 'dilution' effect on the good quality data.

In order to test the most effective methods of integrating databases of varying quality, a series of 3-dimensional subsurface models were created from over 100 borehole records available for the McMaster University campus and surrounding area. Integration of the outputs from models of both high and lower quality data sources creates an output that uses the high quality data to constrain the stratigraphy in localized areas while using the waterwell data to expand the model regionally where data are sparse. This 'integrated' model approach utilizes the strengths of both data sources and can