Chapter 8: Discussion and Conclusions

The availability of a large body of historical nuclear explosion data from Yellowknife Seismic Array has made possible accurate characterizations of P wave attenuation effects along the paths linking this quiescent Canadian listening post with seven of the most active nuclear test areas in the world. The results directly affect the YKA's future capability of making reliable teleseismic yield estimations. The University of Toronto team has also shown that use of the revised P wave attenuation results leads to more interpretable nuclear explosion source functions, including instances of successful unmasking of pP, an elusive depth phase of great importance in seismic source identification and explosion yield estimation.

Our detailed investigation of the epicentral locations of more than 7,000 earthquakes has produced a clear picture of region-specific location correction terms for the YKA. These correction terms, obtained using conventional frequency-wavenumber analysis of vertical-component data, will enable the array to improve the accuracy of its preliminary epicentral determinations for early detection of potentially anomalous seismic events.

State-of-the-art recording instruments of the recently refurbished YKA have ushered in an era of broadband, three-component signal processing. Sophisticated signal processing theories are currently being incorporated into the wavefield decomposition computer codes under development at the University of Toronto. The new array instruments, with their large recording dynamic range and high fidelity, have also prompted the development of a new synthetic seismogram (extended Ray-Kirchhoff) method[22] aimed at taking a fuller advantage of the newly available recording capabilities.

The University of Toronto team has made significant advances in the area of close-in monitoring of the compliance with a future LYTTBT or a CTBT, enabling reliable seismic monitoring of events both at declared test sites and off those sites. Newly developed methods for high-resolution mapping of regional wave attenuation and precise seismic network calibration have effectively reduced the number of recording stations required per event for reliable yield estimation and seismic source identification.

One important implication emerging from our network calibration work is that the gap between the seismic detection threshold (m_b 2.0-2.5) and identification threshold (m_b 3.5) in low-attenuation regions such as the U.S.S.R., currently lying between 1.0 and 1.5 m_b unit for small regional events[23], is closing. As discussed earlier, lowering the identification threshold by less than 0.5 m_b unit will appear to be sufficient to permit monitoring of well-coupled explosions with