Appendix A. Compilation of the lithospheric cross-sections

The cross-sections have been assembled from existing data and interpretations. The interpretations were constructed from the coordinated multidisciplinary research and regional geotectonic knowledge (see Table 1). Active source seismic data played a central role by establishing the present subsurface structure and constraining composition and rheology, thereby making it possible to extend the geological analyses to depth. In order to extend the Lithoprobe corridors to plate boundaries off the west coast and off the continental shelf on the east coast, we have included supplementary data and their interpretations associated with earlier Canadian studies in the region of Haida Gwaii (Queen Charlotte Islands), the 1994 U.S./Canadian ACCRETE program around the Alaska Panhandle-Canadian border area, and the 2001 Geological Survey of Canada Scotian Margin transect. In addition, the sections incorporate estimates of lithospheric thickness from Artemieva (2009) and Shapiro and Ritzwoller (2002).

The active-source seismic reflection data represent a broad range of acquisition vintages, beginning in 1984 with the Vancouver Island segment of the Southern Cordillera transect and culminating in the Western Superior transect in 2001. The Lithoprobe experiments were at the leading edge of deep seismic profiling and the data obtained highlight improvements in data acquisition technology and processing techniques during this time interval. With the near-vertical incidence (NVI) reflection data in particular, there is a progression towards better signal-to-noise ratios and clearer geometric relationships between the surface, crustal reflection patterns, the reflection Moho and mantle reflections.

The refraction/wide-angle studies also improved with time due to technological developments, increased receiver densities through cooperative programs with U.S.

colleagues, and the development of enhanced procedures for data analysis and interpretation. Unfortunately, the costs of drilling, explosives and permitting increased from the first survey in 1984 to the final one in 1997, thereby preventing any enhancement of shot spacing, which typically was 30 to 50 km.

Presenting structural cross-sections on a continental scale is challenging in terms of choosing what parameters to display. Typical choices for interpreted sections are geology or terranes, but for the scales involved these require too much complexity and do not emphasize similarities and differences between orogens. In order to simplify the sections so that comparative structure and collisional sequence were highlighted, we chose to use ‘tectonic age’. We define this as the time since the most recent episode of significant tectonic deformation in an orogen (Fig. 1). The interpreted lithospheric cross-sections and a corresponding map of the orogens and corridors are given in Fig. 2. We recognize that this simplification can, and should, be challenged, particularly for mid-to-lower crustal structures. In certain regions it was difficult to designate tectonic age, particularly for mid-lower crustal structures. Choices were made to convey the sequence of orogenic development based on the current structural interpretations. For example, the Fort Simpson-Wopmay orogen (Northwestern corridor, Fig. 2) was complete in the Paleoproterozoic. After multiple episodes of rifting that gradually produced the western passive margin of Laurentia, the Phanerozoic Cordilleran orogen developed, initially thrusting terranes over the margin and producing a broad thrust-and-fold belt. Technically, the lower-crustal Laurentian wedge over which terranes were accreted was likely deformed by the orogeny and should therefore be assigned a Phanerozoic age. However, we chose to leave it as Paleoproterozoic, but stippled to suggest the Phanerozoic influence. This allows the profile to convey key aspects of structure and the sequence of orogenic development.

The scale of the cross-sections demanded that Earth curvature be included in the presentation. As the transect profiles were published without curvature, they were assembled in that format and then warped with a drawing program to approximate Earth curvature.

The compiled syntheses shown in the Figure 2 foldout are based on previously published research. The following listing includes references for the sources from which the seismic profiles were compiled and the key papers used to develop the interpreted sections. The references are grouped by profile and transect (*SCORD*: Southern Cordillera, *AB*: Alberta Basement, *THO*: Trans-Hudson Orogen, WS: Western Superior, *GLIMPCE*: Great Lakes International Multidisciplinary Program on Crustal Evolution, *AG*: Abitibi-Grenville, *LE*: Lithoprobe East, *SNORCLE*: Slave-Northern Cordillera Lithospheric Evolution, *ECSOOT*: Eastern Canadian Shield Onshore-Offshore Transect). Additional references are discussed in the text and are listed in the papers cited.

a) **Trans-Continental Profile References:** *SCORD* [Clowes et al. 1987a, 1987b; Rohr et al. 1988; Drew and Clowes 1990; Hyndman et al. 1990; Cook et al. 1992; Varsek et al. 1993; Cudrak and Clowes 1993; Zelt et al. 1993; Burianyk and Kanasewich 1995; Clowes et al. 1995; Hasselgren and Clowes 1995; Zelt and White 1995; Spence and McLean 1998; Ramachandran et al. 2006. *AB* [Chandra and Cumming 1972; Ross et al. 1995; Lemieux et al. 2000; Clowes et al. 2002; Gorman et al. 2002; Ross 2002; Shragge et al. 2002; Gorman et al. 2006; Clowes et al. 2010]. *THO* [Lucas et al. 1993; Lewry et al. 1994; Hajnal et al. 2005; Jones et al. 2005; Németh et al.; 2005; White et al. 2005]. *WS* [Kendall et al. 2002; White et al. 2003; Musacchio et al. 2004; Ferguson et al. 2005; Percival et al. 2006]. *GLIMPCE* [Behrendt et al. 1988; Cannon et al. 1989; Shay and Trehu 1993; Allen et al. 2006]. *AG* [Green et al. 1988; Calvert et al. 1995; Martignole and Calvert 1996; Winardhi and Mereu 1997; Waldron et al. 1998; Calvert and Ludden 1999; White et al. 2000; Ludden and Hynes

2000]. *LE* [Hughes et al. 1994; Hall et al. 1998; Waldron et al. 1998; Jackson et al. 1998; Chian et al. 1998; van der Velden et al. 2004; Funck et al. 2004].

b) **Northwestern Profile References:** *SNORCLE/Accrete* [Spence and Asudeh 1993; Bank et al. 2000; Bostock et al. 1998; Morozov et al. 1998; Cook et al. 1999; Hammer et al. 2000; Morozov et al. 2001; Welford et al. 2001; van der Velden and Cook 2002; Bleeker 2003; Fernandez Viejo and Clowes 2003; Cook et al. 2004; Hammer et al. 2004; Cook and Erdmer 2005; Clowes et al. 2005; Evenchick et al. 2005; Fernandez Viejo et al. 2005; Hammer and Clowes 2007; Oueity and Clowes, 2010]

c) **Northeastern Profile References:** *ECSOOT* [Funck and Louden 1998, 1999; Funck et al. 2000a, 2000b; Funck et al. 2001; Hall et al. 2002; Wardle et al. 2002]

Table 1. General summary of techniques used to develop the interpreted lithospheric profiles.

Technique	Primary contributions of the technique
Seismic reflection	Impedance contrasts corresponding to compositional heterogeneities provide high resolution images of structure. The imaged structural fabric provides the framework for subcrustal structure - the third dimension.
Seismic refraction and wide-angle reflection	Velocity models and wide-angle reflections provide lower resolution structural information than near-vertical incidence reflection profiles but constrain composition and temperature.
Teleseismic	Tomographic and reflection analyses of earthquake energy constrain the velocity, anisotropy and rheology of the lithospheric mantle and the crust-mantle boundary.
Aeromagnetics	Magnetic anomalies permit interpretation of geological domains and features beneath sedimentary cover and overburden.
Gravity	Gravity anomalies constrain density structure within the crust.
Magnetotellurics	Crustal and mantle conductivity constrains some crustal structures (e.g., fault zones) and lithospheric thickness.
Heat Flow	Constrains crustal strength and rheology
Paleomagnetism	Constrains thermal history and movements through geological time of terranes, microcontinents and continents
Physical Properties	Rock properties provide constraints on interpretation of geophysical data

Geological Mapping and Structural Geology	Provides the underlying foundation to all of the Lithoprobe results.
Geochemistry and Petrology	Constrains composition, depth, temperature and dynamics
Geochronology, including Paleontology	Radioisotopic and paleontological dating provide the kinematic framework necessary for development of the models of tectonic evolution.
Geodynamic Modelling	Finite-element and finite difference models of tectonic interactions