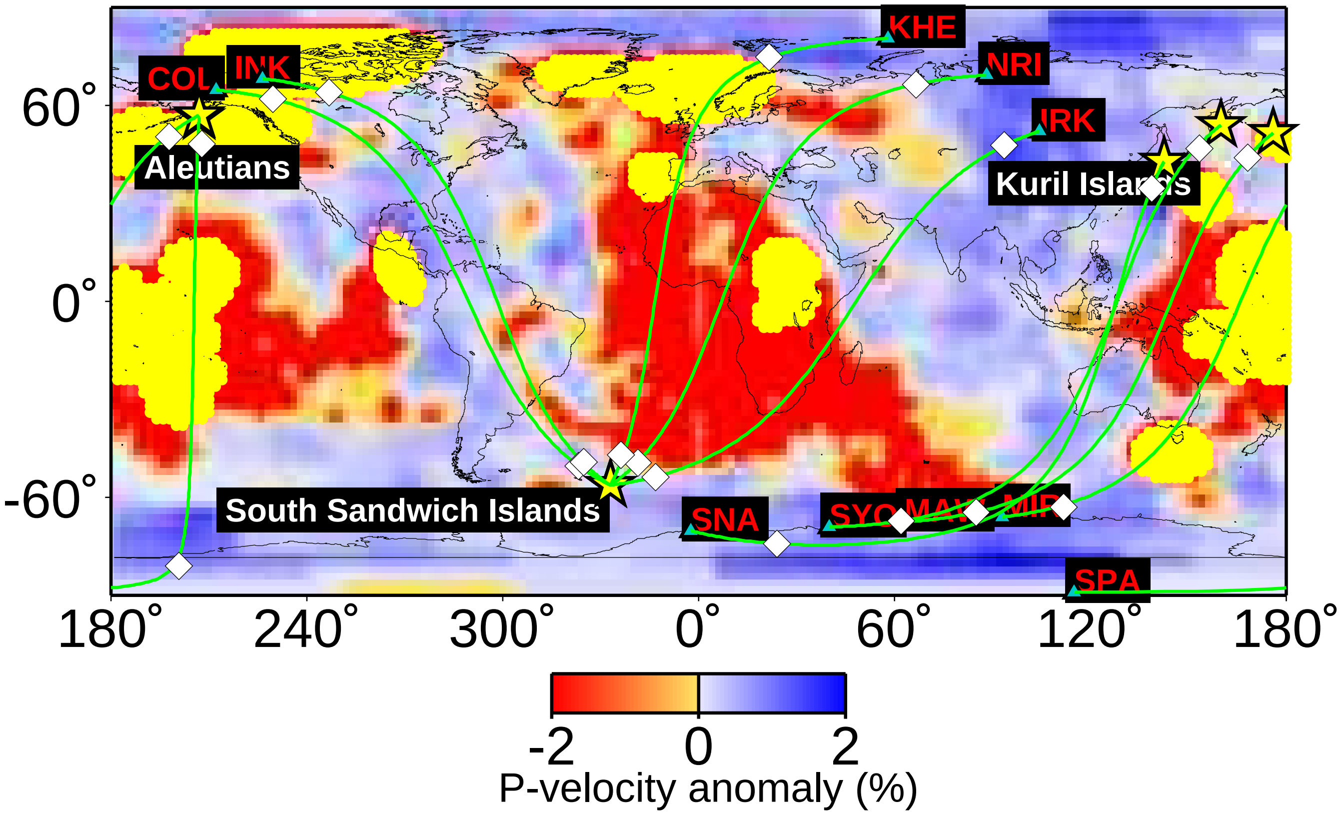

Figure 11.3: Near polar source-receiver paths analysed in this study. Stations, source regions, and great circle paths are indicated by blue triangles, yellow stars, and green lines respectively. Plotted as background is Grand et al.'s [1997] tomographic model for which we have converted S-velocity to P-velocity using the scaling dlnVs/dlnVp=2. This model was found to be a good starting point to describe the large scale distribution of P-velocity in D" on the global scale [*Bréger et al.*, 1999], including low velocity regions in the Pacific and under Africa. Yellow patches indicate the regions where Ultra Low Velocity Zones [*Garnero et al.*, 1998] have been detected. Outer core DF penetration points are indicated by white diamonds.

3. Anomalous splitting of core sensitive modes: a reevaluation of possible interpretations

B. Romanowicz and L. Bréger

3.1 Introduction

Inner core anisotropy was proposed 13 years ago to explain two categories of intriguing observations: (1) faster propagation times for seismic body waves that travel through the inner core along paths quasi-parallel to the earth's rotation axis, than for those that travel on equatorial paths (Poupinet et al., 1983; Morelli et al., 1986), and (2) anomalous splitting of core-sensitive free oscillations (Masters and Gilbert, 1981; Woodhouse et al., 1986). These observations have been confirmed in many subsequent studies (e.g. Shearer, 1991; Creager, 1992; Vinnik et al., 1994; Su and Dziewonski, 1995) and models of inner core anisotropy have been progressively refined. These models were originally cast in terms of constant transverse isotropy with fast axis parallel to the earth's rotation axis, for which an interpretation in terms of alignment of hcp-Fe crystals was proposed. Over the years, inner core anisotropy models have become more complex. Depth dependence was introduced (Su and Dziewonski, 1995; Tromp, 1993) and more complex spatial dependence suggested (Li et al., 1991; Romanowicz et al., 1996; Durek and Romanowicz, 1999). Most recently, several studies have proposed even stronger departures from simple models of inner core anisotropy. An asymmetry in the anisotropy pattern was pointed out (Tanaka and Hamaguchi, 1997; Creager, 1999), with one "quasi-hemisphere" of the inner core anisotropic and the other not, and it has been argued that the top 100-200 km of the inner core may be isotropic and laterally varying (Song and Helmberger, 1998). Strong, small scale variation in the anisotropy along a highly anomalous path between the South Sandwich Islands and station COL in Alaska has also been documented (Creager, 1997).

The necessity to modify the simple original model of constant anisotropy, and introduce significant complexity, has become quite clear. Moreover, we have recently proposed that an important contribution to the trend of travel time residuals, as a function of angle of the path with respect to the rotation axis, for PKP(AB)-PKP(DF) data, could come from strong heterogeneity in D" (Bréger et al., 1999a) and we proposed a possible trade-off between D" structure and inner core anisotropy in the interpretation of differential PKP travel time data (also PKP(BC)-PKP(DF), Bréger et al., 1999b).

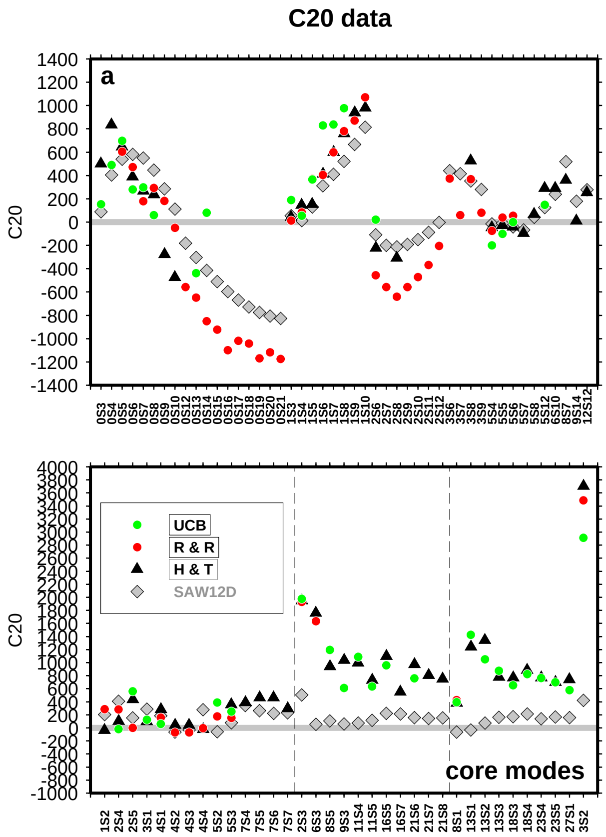

Figure 11.5: Splitting data for C20, relative to the center frequency, in 10^{-6} units (cf He and Tromp, 1996) from various sources, and predictions for a global tomographic model of the mantle (SAW12D). UCB: from Durek and Romanowicz (1999); *R&R*: from Resovsky and Ritzwoller (1998); *H&T*: from He and Tromp (1996). (a) "mantle modes"; (b) "core modes". The core modes have been subdivided (vertical broken lines) into those that have no sensitivity to inner core structure (1S2-7S7), those that have small sensitivity to inner core structure (2S3-21S8) and those that have more than 4% of their energy in the inner core (8S1-3S2).