Polonaise 1997

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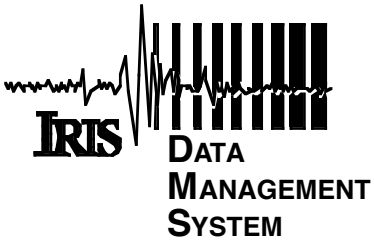

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Report of Investigation

The Trans-European Suture Zone (TESZ) is the most important geologic boundary in Europe north of the Alpine orogenic belt and begins at the western edge of the Precambrian East European Craton (EEC). The TESZ is the result of complex plate convergence which formed Pangea and thus Europe as we think of it geographically today. A large seismic experiment, just completed (May 31st !!) in Poland, targeted the deep structure of the TESZ and the complex series of upper crustal features associated with it. This international cooperative effort, known as POLONAISE, is led by the Association for Deep Geological Investigations of Poland (ADGIP) with the support of the Institutes of Geophysics of the Polish Academy of Sciences and the University of Warsaw. The TESZ has been recognized as a feature of key scientific importance by the European Science Foundation's EUROPROBE program which has sponsored a series of workshops to encourage scientific collaboration to study this feature. As a result, POLONAISE included contributions from the geophysical communities in Poland, Denmark, the USA, Lithuania, Finland, Sweden, Germany, and Canada. Funding for ADGIP and POLONAISE has primarily come from the Polish Oil and Gas Company, the Polish Geological Survey, and the Polish Academy of Sciences. In addition, the Danish Natural Science Research Council supported the participation of the Geological Institute of the University of Copenhagen through which over 170 instruments were provided by the Geological Survey of Canada.

Support from the U. S. National Science Foundation to the University of Texas at El Paso provided over 300 instruments from the IRIS-PASSCAL/Stanford University instrument center. The final experiment is perhaps the largest entirely land-based lithospheric seismic experiment ever undertaken, with about 600 instruments being deployed to record 63 shots along 5 profiles with a total length of about 2000 km.

The Trans-European Suture Zone (TESZ) is a broad, structurally complex zone of middle to late Paleozoic accretion and deformation which separates the Precambrian terranes of the Baltic shield and East European Craton from the younger terranes to the south (Fig. I) (Berthelsen, 1992). The TESZ can be traced from the British Isles to Poland where it narrows and becomes approximately coincident with the Teisseyre -Tornquist Zone (TTZ). The TESZ is a manifestation of the complex collisions associated with the formation of Pangea during the Paleozoic and can be traced westward across the Atlantic Ocean to the Appalachian orogen. Tomographic analysis of the shear wave velocity structure of the mantle under Europe (Zielhuis and Nolet, 1994) shows that the TESZ in the region of Poland is a very deep-seated structure separating regions of high velocity to the NE from low velocity regions to the SW. Geologic studies (e.g., Dadlez et al., 1994) indicate that the TESZ / TTZ has also influenced the evolution of younger upper crustal features. Much of Poland and northern Germany is covered by a deep (>10 km) basin, usually called the Permian or Polish basin, which filled with Permian and Mesozoic sedimentary rocks during a phase of extension after the Variscan orogeny. These rocks contain significant petroleum reserves and include the well known Zechstein salt which has hampered seismic imaging of the pre-Permian strata and structures. The Alpine orogeny caused inversion of TTZ structures in Poland to create a NW trending zone of uplifts which pass through the Permian basin and extends to the NW into Denmark and Sweden. The Holy Cross Mountains in which Caledonian structures are exposed is the best known of these uplifts.

In addition to many Deep Seismic Sounding (DSS) profiles in Poland (Guterch et al., 1986), a series of recent seismic studies in the Baltic / North Sea area have provided many new insights on lithospheric structure in the TESZ region. The British program of deep seismic reflection profiling

(BIRPS) has recorded numerous images of TESZ-related structures in the western North Sea (e. g., Klemperer and Hobbs, 1992). The MONA LISA project in the southeastern North Sea produced good images of the Caledonian deformation front just west of Denmark. Two models of the collision which produced this deformation appear to fit these data (MONA LISA Working Group, 1997). As part of the European Geotraverse Project (Blundell et al., 1992), a series of refraction profiles crossed Denmark and Sweden and revealed significant variations in crustal thickness in the vicinity of the TTZ (EUGENO-S Working Group, 1988). The BABEL project in the Baltic Sea delineated thick crust under and to the NE of the Sorgenfrei-Torquist zone (STZ) which is an extension of the TTZ (BABEL Working Group, 1993). In northwesternmost Poland, the LT-7 seismic profile which was a precusor to POLONAISE showed that the crustal thickness near the TESZ / TTZ was intermediate between that of the East European Craton to the east (~42 km) and that (~30 km) in the area to the west near the Polish/German border (Guterch et al., 1994). In central and southeast Poland, early DSS studies showed that the TESZ is associated with a crustal root in which the thickness exceeds 50 km locally (Guterch et al., 1986). These studies provide an excellent framework for the analysis of the results from POLONAISE.

POLONAISE involved two deployments of about 600 instruments. However, the basic layout of 4 interlocking profiles was the same in both deployments, and only a small percentage (<20%) of the recording stations were moved. Line 4 extended completely across Poland and most of Lithuania. For this profile, 1 shotpoint was located in Germany and 3 were located in Lithuania. An example of the data obtained is shown in Figure 3 where good arrivals from the upper mantle are observed out to offsets of greater than 600 km from only a 300 kg charge (SP402). The reason for such outstanding source efficiency is a question to be investigated. In the western U. S., results of past studies suggest that a charge about 20 times this size would be required to produce good signals at such distances. The wet climate of Poland and the cratonal nature of part of the area explains some of this difference in wave propagation and source coupling. However, the extent of the difference is remarkable especially considering the unsettled weather at the time of the shot and the cultural noise present due to the rural population density.

The scale of the POLONAISE field effort was without precedent. The field work took place during the last two weeks of May, 1997. Power and storage limitations of some of the instrumentation dictated that the shooting be done over at most two nights for each deployment. Thus, 15 crews, consisting of about 15 persons each, from local seismic contracting companies (Geofizyka Torun and Geofizyka Krakow) were contracted to drill and load the shot holes and detonate them at a scheduled time using GPS timers. The instrument deployment required 30 crews of 2-3 persons and considerable technical support. In addition, about 800 recording locations had to be permitted and surveyed. Communication during this complex operation was good thanks to the project being able to rent 75 cellular phones. Instrumentation failures were minimal and all of the shots were recorded. The vast data set produced will take several years to fully analyze.

In the short term, the goal of ADGIP is to obtain traditional multifold seismic reflection data along most of profiles I and 4 (Fig. 2). In the long term, the goal is to conduct an similar coordinated seismic refraction and reflection experiment in southern Poland. ADGIP is not just a seismic project because it includes the integration of gravity, magnetic, drilling. and geologic data. The final result should be much better understanding of the geologic evolution of the TESZ and the Permian basin of central and western Europe

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Polonaise 1997 READ ME file:

This directory structure contains Standard SEGY shot gathers (.sgy) from the Polonaise experiment in Poland in 1997. This was a refraction project. There was a project in 2000 (Celebration 2000) that could be considered a continuation of Polonaise.

The shot gathers are broken down into north-south (_n), east-west (_e) and vertical (_z) components.

The geometry should be loaded into the headers.

Rectangular coordinates were used with mapproject command.

mapproject $tsp/geom/rec.dd-Jml:0.9996 -R13/51/26/55r-F-: | awk -f $tsp/csh/refmtxy.awk>! $tsp/geom/rec.xy

This means it is in Mercator, with the beginning of the coordinate frame on lat 51N, lon 13 E.

Geographical coordinates (in seconds of arc) are located in non-standard part of the SEG-Y trace header.
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bytes 225-228 receiver geo.lon
bytes 229-232 source geo.lat
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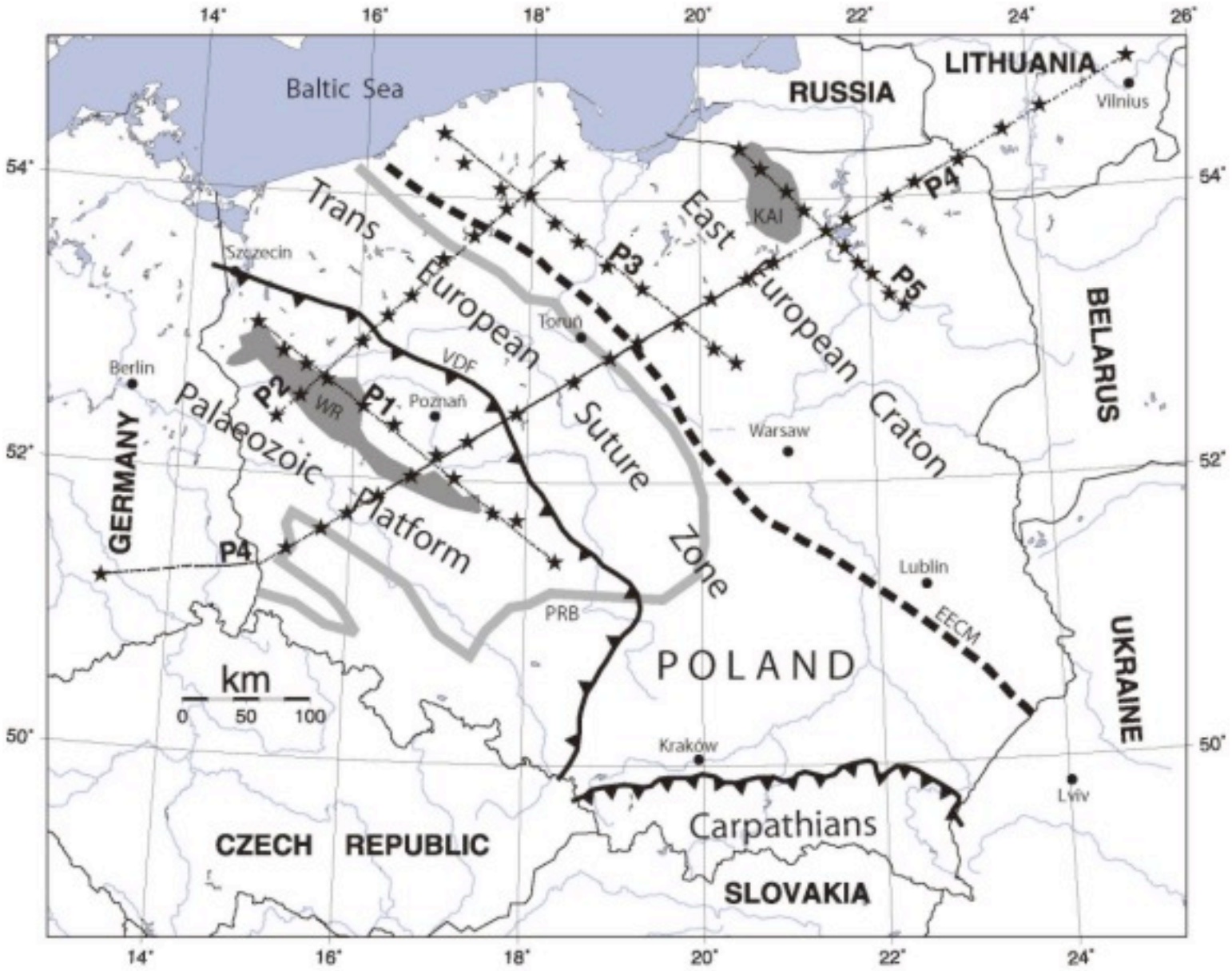
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SLOVAKIA
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Suture
Zone
East
European
Craton
Palaeozoic
Platform
Szczecin
Berlin
Poznań
Toruń
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