PRAKLA-SEISMOS INFORMATION No. 30

Static Correction Techniques

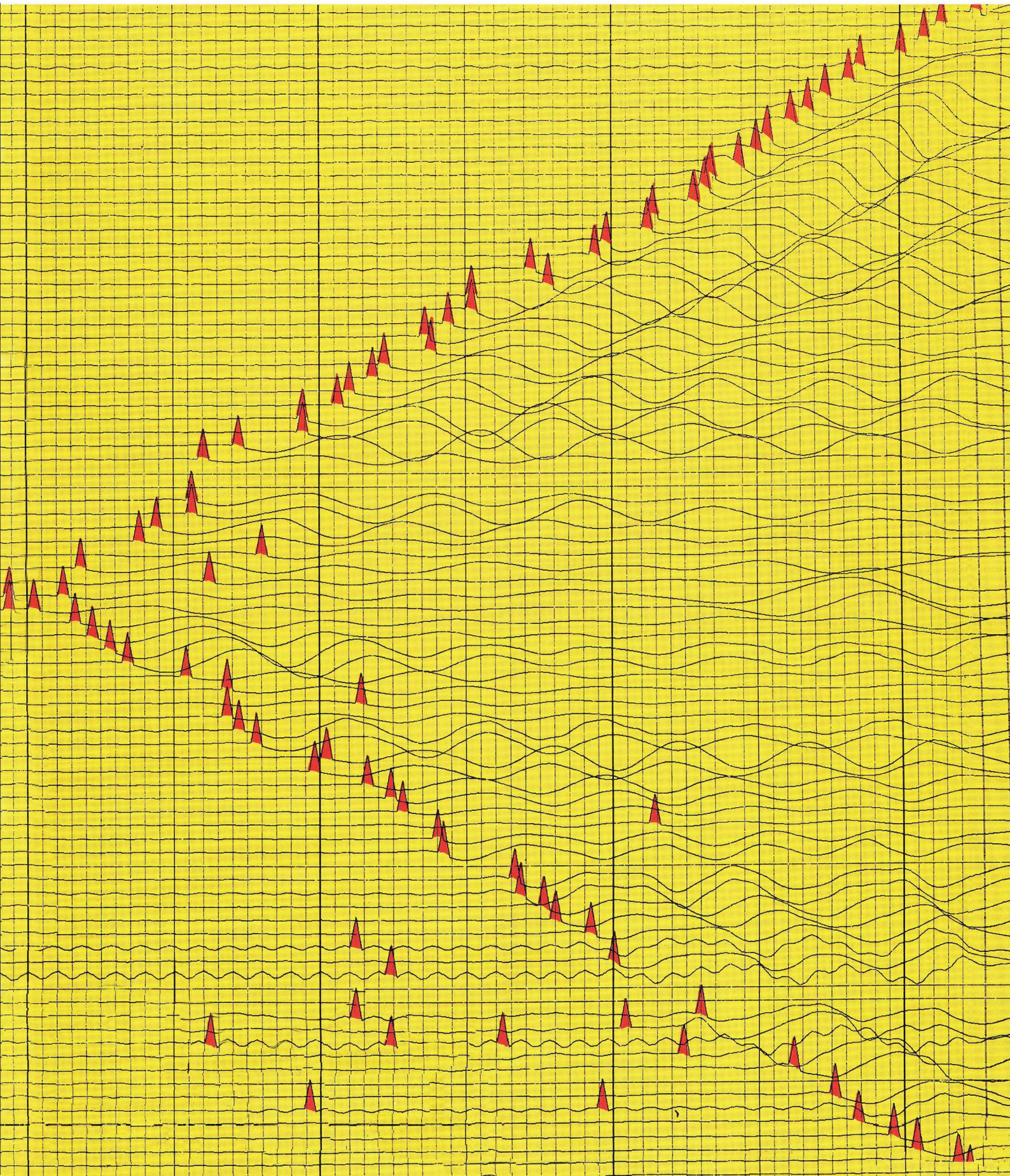

Table of static correction programs

				Interactive Programs: hand digitizing	Interactive Programs: automatic digitizing	Fully automatic programs
2-D	basic static corrections	Borehole data and uphole times or data from a velocity-model				BOMO**
		Data from short refraction surveys		SHORE 1* SHORE 2*	in preparation	
		Data from seismograms of seismic reflection surveys	using first arrivals	BASCO 1*	BASCO 2*	
3-D			using first arrivals	ARBASCO	in preparation	
2-D	statistical improvement of basic static corrections		using first arrivals	STIFA 1*	STIFA 2*	
			using reflections	STACO* MEALI** OCATS**	projected	2-D-ASTA**
3-D			using reflections			3-D-ASTA

* Receiver positions equidistant on straight lines only

** Receiver positions on crooked lines possible

PRAKLA-SEISMOS' many activities in seismic surveys in swamp, moraine, or molasse areas, and in shallow-water surveys combined with land connections stimulated an intensive development of static correction methods from the very beginning. The introduction of **desk-top computer units** in 1977 permitted the economic application of interactive programs using methods not normally applied before. In 1981 a further decisive step was taken by the **automatic picking** of first arrivals. The data – read directly from the magnetic tapes – are immediately available and the increased data volume of present surveys can be processed economically.

The table on the left page shows which static correction programs are applied by PRAKLA-SEISMOS. In all these programs the static corrections are surface consistent. Short descriptions of them are to be seen below; they are divided in two groups:

- Basic static corrections – their application avoids long period statics to a very great extent
- Improvement of basic static corrections.

SHORE and BASCO are programs especially suited to lines with the seismic source in the weathering layer.

Two additional programs can be applied on static corrections determined by programs listed in the table:

SLODA: SLOping **DA**tum level, divides the static corrections related to a common datum level in parts above and below a sloping datum level.

DYSTA: Consideration of **DY**namic influence on **STA**tic corrections.

For very short reflection times and large source-receiver distances the surface-near raypaths deviate considerably from vertical incidence. The static correction values, however, represent the vertical paths. If static correction values related to a common midpoint are very different, then the stack result can be optimized by DYSTA.

Automatic Picking

Programs BASCO 2 and STIFA 2 include the automatic picking process. In the automatic picking process about 10 to 30 % of the picked data may be incorrect. They are sorted out in two steps:

1. Filtering before further processing in a relatively large time-gate.
2. Filtering by the internal logic of further processing steps.

In the case of a good signal to noise ratio BASCO 2 and STIFA 2 are controlled by fixed parameters instead of interactively determined parameters; this means: **A gradual transition into a fully automatic process is possible.**

Short Description of the Programs Available (see Table)

Determination of Basic Static Corrections

1. **BOMO:** Determination of basic static corrections using data from **BO**reholes drilled down to the subweathering and/or **MO**dels of near surface layers.

2. **SHORE:** Determination of basic static corrections using data from **SHO**rt **RE**fraction surveys.

   SHORE 1 was developed specifically for the two-layer case. The program allows an interactive working procedure with intermediate results being shown on a graphic screen. The travel-time curves are interpreted according to Hagedoorn's Plus-Minus-Method. The results are the basic static corrections and a depth section of the refractor.

   SHORE 2 is applied for multi-layer cases:

   Step 1, digitizing of first arrivals and automatic plotting;
   step 2, interpretation of travel-time curves and determination of t-plus and t-minus values from the plots of step 1 by hand;
   step 3, input of results of step 2.

   Results are the basic static corrections and an automatic output of the depth section of the refractors.

3. **BASCO:** Determination of **BA**sic **S**tatic **CO**rrections using first arrivals

   BASCO uses intercept times of one refractor at the seismic source positions. BASCO can also be applied to a three-layer case after introduction of a defined intermediate horizon.

   BASCO requires absolute travel times considering the parameters of the seismic source, the delay of the field recording filters, the geophone pattern length and, if necessary, a phase correction. The intercept times at source positions are determined multifold according to the multiplicity of surface coverage. The correction velocity is calculated from t-minus values (Hagedoorn). The results are the plots of travel-time curves, of intercept times, a depth section of the refractor, basic static corrections at the source positions and interpolated corrections (with respect to elevations) at the receiver positions.

4. **ARBASCO:** Determination of **AR**eal **BA**sic **S**tatic **CO**rrections using first arrivals

   ARBASCO can cope with 3-D-recordings up to 240 traces; it assumes that the shot lies beneath the weathered layer. The absolute first arrival times are digitized in the common shot domain. By re-sorting according to common receiver positions the intercept times and the local refractor velocities at all these posi-

tions can be determined. From the intercept times of those receivers, which are adjacent to shotpoints, and from the well data of those shotpoints, the thickness and velocity of the weathered layer can be calculated at these places. ARBASCO then calculates the thicknesses of the weathered layer and the static corrections for the receiver side from the intercept times at every receiver position, from the interpolated velocities of the weathered layer and from the regional refractor velocity.

Statistical Improvement of Basic Static Corrections

5. STIFA: **ST**atistical **I**mprovement of basic static corrections using **F**irst **A**rrivals

STIFA, being a relative correction method, determines the delay times in the weathered layer at the receiver positions using the travel times of first arrivals. The travel times are corrected with respect to the elevations. These new values are calibrated using basic static corrections; dependent upon surface coverage a statistical improvement of static corrections results at seismic sources and receiver positions.

If basic static corrections had been calculated by BASCO, STIFA follows as a fully automatic process.

6. STACO: **STA**tistical improvement of basic static **CO**rrections using reflection data (sorted in the common source domain)

STACO operates with relative reflection travel times. They are digitized according to the receiver positions and calibrated using basic static corrections. Hyperbolas through these calibration values are calculated and the time differences between reflection travel times and the hyperbola values are determined. Averaging these time differences at every receiver position a statistical improvement of static corrections, dependent upon surface coverage, is obtained. The improvement at the receiver positions is transferred to the source positions. STACO includes BOMO.

7. MEALI: Statistical improvement of basic static corrections using reflection data from **MEA**nder **LI**nes (crooked lines)

MEALI is a variant of STACO for crooked lines. The field geometry is given by data sets of coordinates or by digitizing the coordinates on a location map. In the hyperbola calculation (see STACO above) the true distances between sources and receivers are taken into account.

8. OCATS: Inverse STACO (re-sorted into common receiver domain)

OCATS statistically improves basic static corrections on the source side and uses reflection times of straight as well as of crooked geophone lines.

In part 1 of the program the static corrections on the receiver side are statistically improved and applied, using the same system as in STACO or MEALI. In part 2, after re-sorting the data – arranged according to common receiver positions – the same process sequence is carried out again; this leads to statistically improved corrections on the source side.

A prerequisite for using OCATS is that it must be possible to digitize and follow the same phase of reflection events for one horizon.

9. ASTA: 2-D and 3-D **A**utomatic residual **STA**tic corrections

ASTA determines the displacements of the individual single traces at a common midpoint by comparison with a reference trace built up from a modified raw stack. From the displacements surface-consistent source and receiver corrections are calculated according to a statistical method.

For more details see PRAKLA-SEISMOS Information No. 9, "Iterative Residual Static Corrections".

Hardware Used for Interactive Static Correction Programs

1. HEWLETT-PACKARD desk-top computer 9845 B (450 kbyte memory, 2 tape drives, graphic screen, internal thermoprinter)
   HP digitizer 9874 A;
   HP floppy-disk drive 9895, 2x1 Mbyte;
   HP plotter 9872 S or CALCOMP drum plotter 1039;
   HP magnetic-tape drive (1/2″).

2. VAX-11/780 computer system
   5 magnetic tape drives;
   TEKTRONIX graphic screen;
   VERSATEC electrostatic plotter, 22″;
   line printer.

The automatic analysis of first arrivals is carried out on the VAX-system. Further interactive processing can be continued on either system.

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