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M E M O

DATE: April 23, 1990

TO: Gregg Jilson
Vice President, Exploration
Curragh Resources Inc
117 Industrial Road
Whitehorse, Yukon
Y1A 2T8

FROM: C. Grant
William Hill Mining Consultants Limited

RE: FARO VARIOGRAMS

Attached are copies of the blasthole Variograms run on our GEOSTAT software here in the office. We used the same data as in the GEMCOM runs and with the same parameters (spread angle, cut-offs, step distances, etc.)

The results from GEOSTAT are similar but not identical to your GEMCOM Variograms which is probably because of the different algorithms used. Attached is an explanation of the GEOSTAT procedure.

The GEOSTAT graphs show most of the ranges indicated by GEMCOM except for the N-S direction which is not as clear as GEMCOM (this may be particularly because of the scale used).

Once I have finished with the Vangorda work, I will run some more Variograms to examine this N-S direction more closely.

Regards,

CG

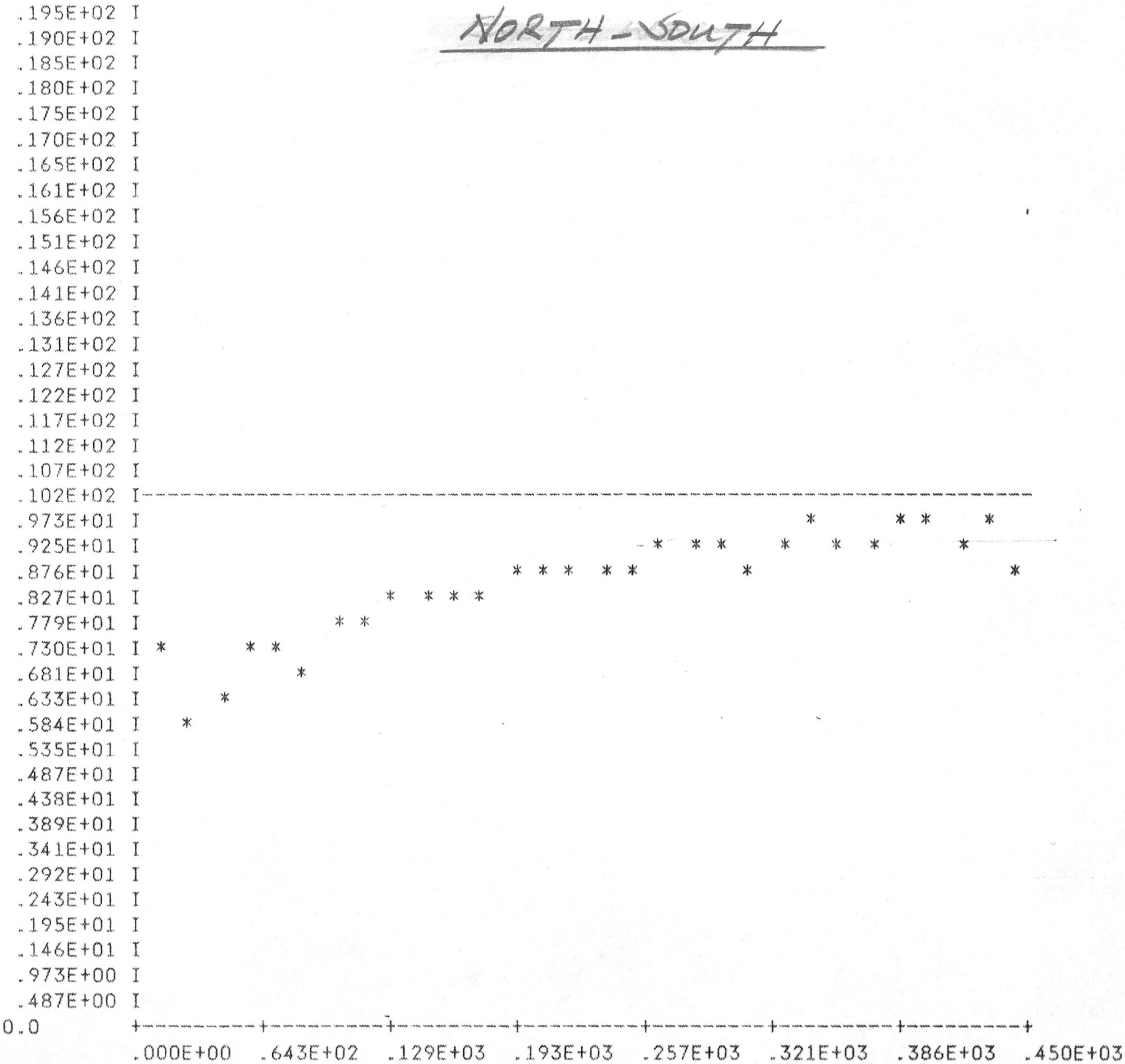
```
   LOCAL    REL. VAR.     =     .33810E+00
   LOGARITHMIC VARIANCE =     .43043E+00
1                         CURRAGH S PHASE VARIOGRAMS           ALL 20FT BLASTHOLE BENCH COMPOSITES
                                                ABSOLUTE        VARIOGRAM
  VARIABLE (PBZN) +++ ANGULAR DIRECTION (     .0) +++ ANGULAR WINDOW (  22.5)
  .195E+02 I
  .190E+02 I
  .185E+02 I
  .180E+02 I
  .175E+02 I
  .170E+02 I
  .165E+02 I
  .161E+02 I
  .156E+02 I
  .151E+02 I
  .146E+02 I
  .141E+02 I
  .136E+02 I
  .131E+02 I
  .127E+02 I
  .122E+02 I                             * * *
  .117E+02 I                      * * *         *
  .112E+02 I                   *                  * *
  .107E+02 I                 *                         *
  .102E+02 I---------------*-----------------------------*-*----------------------
  .973E+01 I                                                           * *  * * *
  .925E+01 I          * *                                     * * *  *
  .876E+01 I
  .827E+01 I
  .779E+01 I        *
  .730E+01 I *    *
  .681E+01 I
  .633E+01 I   *
  .584E+01 I
  .535E+01 I
  .487E+01 I
  .438E+01 I
  .389E+01 I
  .341E+01 I
  .292E+01 I
  .243E+01 I
  .195E+01 I
  .146E+01 I
  .973E+00 I
  .487E+00 I
  0.0      +---------+---------+---------+---------+---------+---------+---------+
           .000E+00  .643E+02  .129E+03  .193E+03  .257E+03  .321E+03  .386E+03  .450E+03
                                                           AVERAGE DISTANCE
1                                                        V A R I O G R A M
```

EAST-WEST

1 CURRAGH S PHASE VARIOGRAMS ALL 20FT BLASTHOLE BENCH COMPOSITES

ABSOLUTE VARIOGRAM

VARIABLE (PBZN) +++ ANGULAR DIRECTION (90.0) +++ ANGULAR WINDOW (22.5)



V A R I O G R A M

1

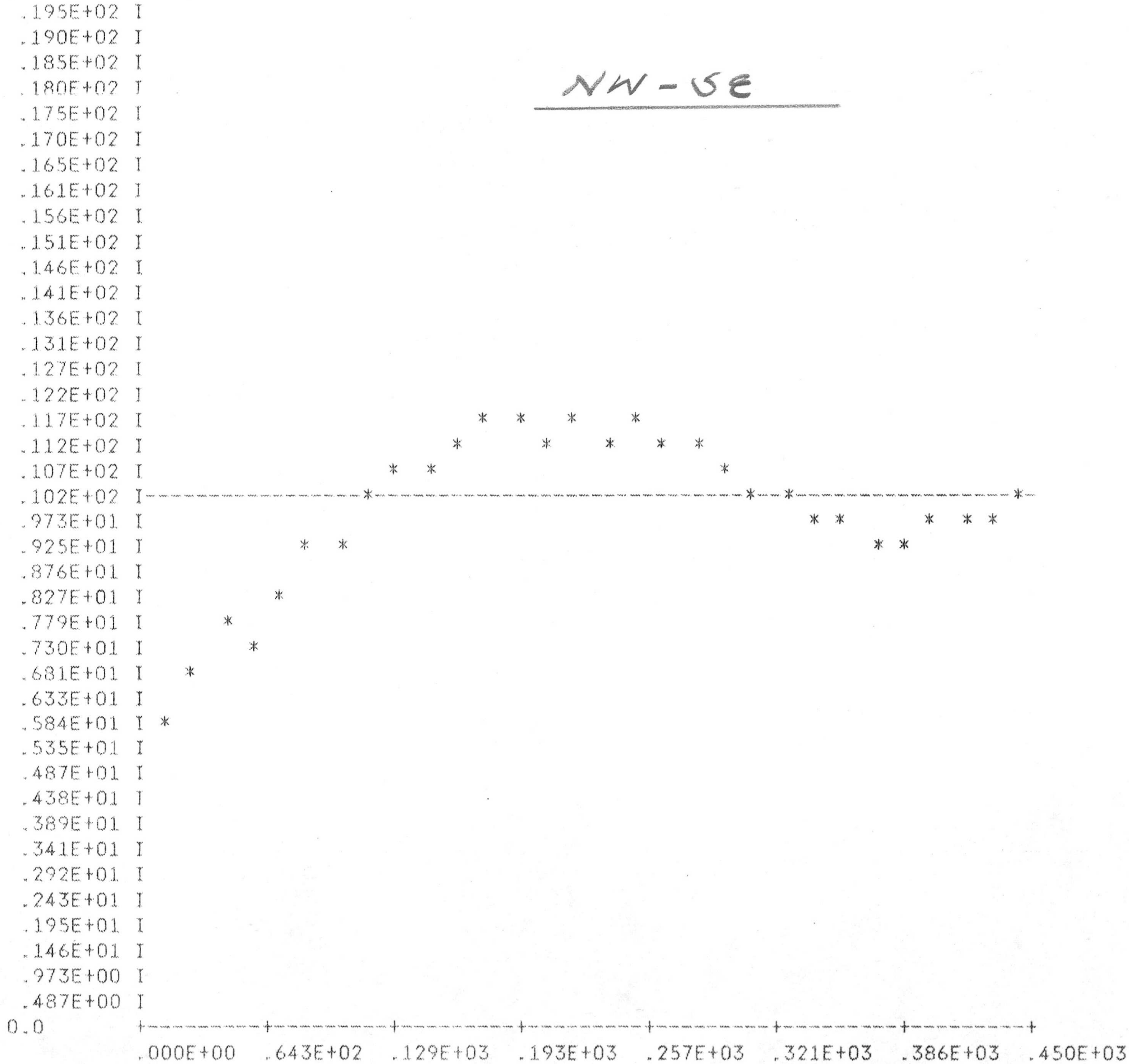
CURRAGH S PHASE VARIOGRAMS ALL 20FT BLASTHOLE BENCH COMPOSITES

LOGARITHMIC VARIANCE = .43043E+00

1 CURRAGH S PHASE VARIOGRAMS ALL 20FT BLASTHOLE BENCH COMPOSITES

ABSOLUTE VARIOGRAM

VARIABLE (PBZN) +++ ANGULAR DIRECTION (135.0) +++ ANGULAR WINDOW (22.5)



1 VARIOGRAM

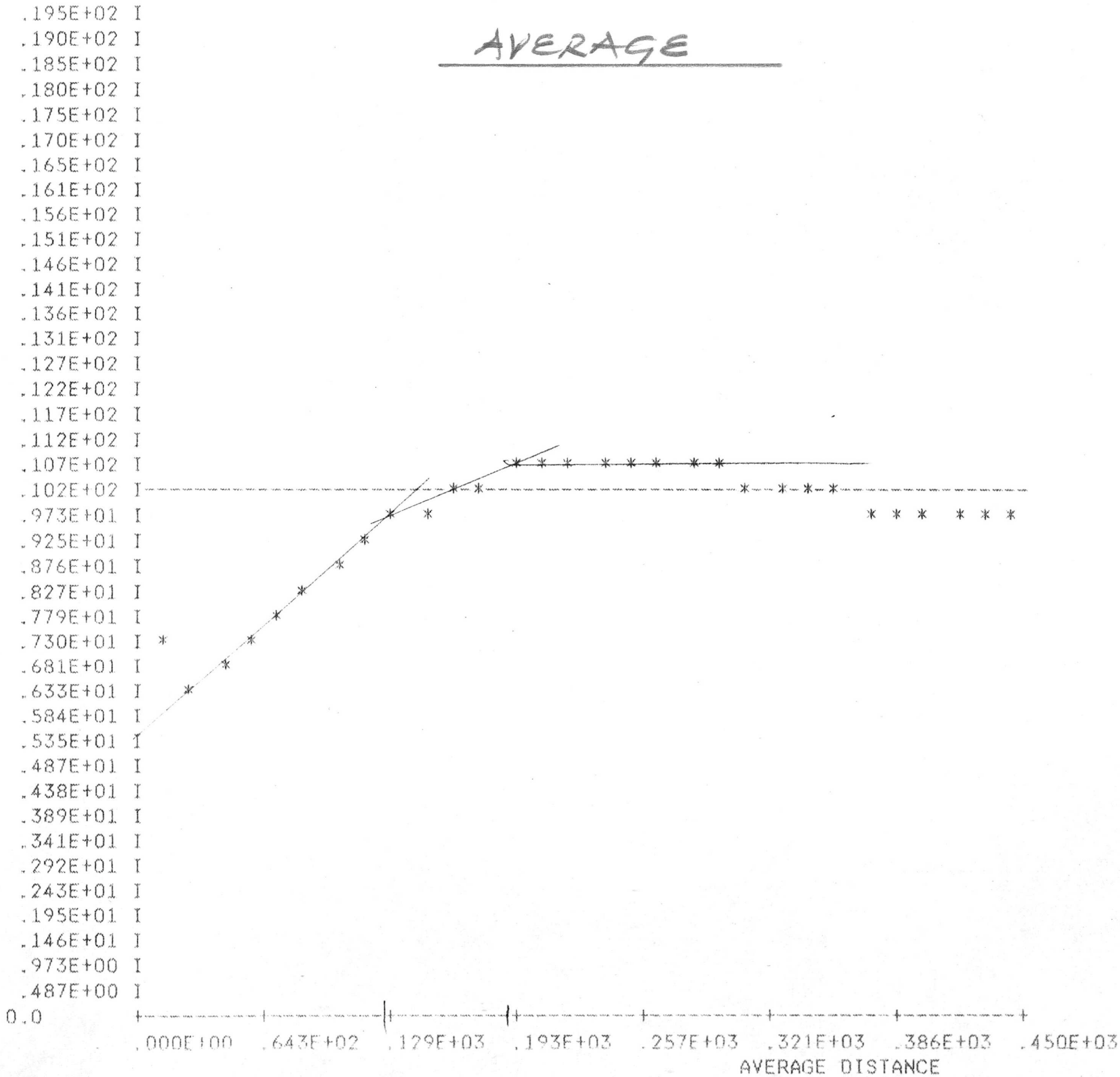
```
LOCAL    REL. VAR.     =    .32003E+00
LOGARITHMIC VARIANCE =    .43043E+00
1                              CURRAGH S PHASE VARIOGRAMS              ALL 20FT BLASTHOLE BENCH COMPOSITES
                                                      ABSOLUTE         VARIOGRAM
 VARIABLE (PBZN) +++ ANGULAR DIRECTION (  45.0) +++ ANGULAR WINDOW (  22.5)
  .195E+02 I
  .190E+02 I
  .185E+02 I
  .180E+02 I
  .175E+02 I
  .170E+02 I
  .165E+02 I
  .161E+02 I
  .156E+02 I
  .151E+02 I
  .146E+02 I
  .141E+02 I
  .136E+02 I
  .131E+02 I
  .127E+02 I
  .122E+02 I
  .117E+02 I                                           * * *  * *
  .112E+02 I                                    * * *             *  *
  .107E+02 I                               * *                         *
  .102E+02 I-----------------------------*-------------------------------*--*-*---
  .973E+01 I                      * * *                                         *
  .925E+01 I                   *
  .876E+01 I                 *
  .827E+01 I *          *  *
  .779E+01 I          *
  .730E+01 I
  .681E+01 I      * *
  .633E+01 I
  .584E+01 I
  .535E+01 I   *
  .487E+01 I
  .438E+01 I
  .389E+01 I
  .341E+01 I
  .292E+01 I
  .243E+01 I
  .195E+01 I
  .146E+01 I
  .973E+00 I
  .487E+00 I
  0.0      +---------+---------+---------+---------+---------+---------+---------+
           .000E+00  .643E+02  .129E+03  .193E+03  .257E+03  .321E+03  .386E+03  .450E+03
                                                           AVERAGE DISTANCE
1                                                        V A R I O G R A M
```

NE - SW

CURRAGH S PHASE VARIOGRAMS ALL 20FT BLASTHOLE BENCH COMPOSITES

ABSOLUTE VARIOGRAM

VARIABLE (PBZN) +++ ANGULAR DIRECTION (.0) +++ ANGULAR WINDOW (180.0)



Because the distance (h) separating the points of contributing pairs are not multiples of an elementary distance, the program must be given a unit distance (STEP) that can be taken on average as this elementary distance. A good approximation would be the average drilling grid size (or a sub-multiple of it), or in the absence of even the shadow of a grid, a value slightly more than the average distance between adjacent holes.

The program proceeds by computing the variogram for all pairs falling within multiples of STEP and gives the value to a point situated at a distance corresponding to the average h of all contributing pairs (figure 2).

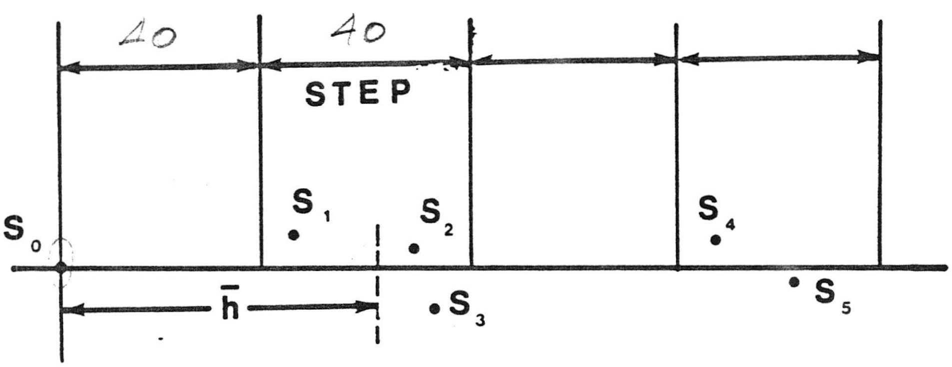


Figure 2

VARIOGRAMS IN 3D

Computing variograms in 3D on irregularly gridded data is usually a time consuming task: Experience has shown that applying the principles used in 2D in the 3D case leads to program run times that quickly become astronomical.

The **VARIO3** program uses shortcuts that permit computations of variograms in MOST 3D DIRECTIONS.

When the IVERT option is set to 1, the program reads 3 coordinates (X,Y,Z) with every sample, and having read the data file, sorts it internally on the Z coordinate.

The user in this case is asked to specify a search radius (ZDMAX) in the Z direction.

Variograms are thus computed in the X-Y plane using (as in 2D) only the samples that fall with the PSI angular window around the PHI direction, but WITH THE ADDED CONDITION that a pair of points is used only if the difference in Z coordinates does not exceed ZDMAX.

As shown in figure 3 the variogram contributing pairs are all the pairs falling within a "pie slice" centered at the origin. The final variogram in direction PHI is thus the average of all variograms computed on slices in the Z direction.

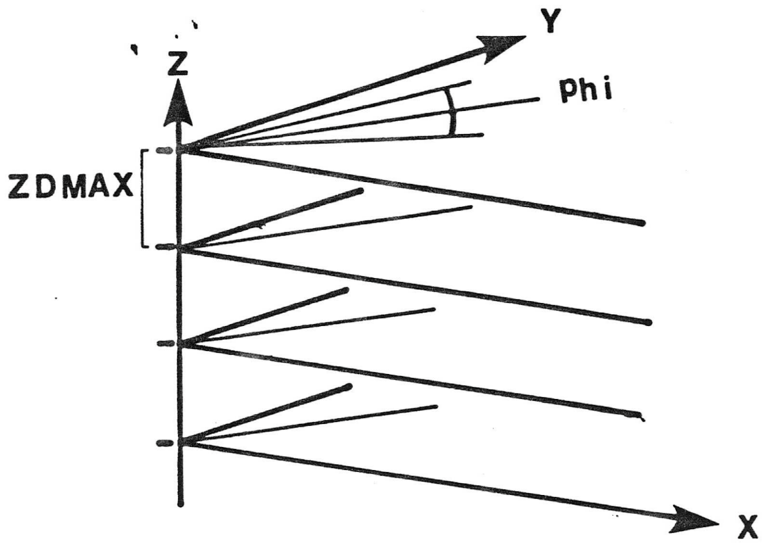


Figure 3

Since the variograms are only computed in the X-Y plane, to compute variograms in other directions, the user has only to invert the (X-Z) or (Y-Z) axes by reading the Z coordinate as the Y and the Y as the Z through control variable ORDER and format commands. Thus variograms computed by **VARIO3** in "what it believes to be" true X and Y plane will actually be computed on (X-Z) or (Y-Z) planes. To simplify the entry of the 3 coordinates, the user can specify the order in which the coordinates are read. For instance, if the user sets ORDER variable to XYZ, the program will assume that the first 3 values read from the data file are the X, Y and Z coordinates, respectively. However, by specifying XZY, the user is forcing the program to take the second coordinate as Z and the third as Y, thus effectively inverting the Y and Z axis.

It should also be noted that using a simple program that performs coordinate rotations, the user will be able to compute variograms in every possible direction. Program ROT is such a program although most program libraries offer an equivalent.