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Record No. 1971/8

Improvements to BMR's Gravity Retrieval System, June, 1969

by

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SUMMARY

This Record describes a computer programme LOCATE which extracts gravity station data directly from library magnetic tapes within given geographical boundaries, and computes their Bouguer anomalies for up to seven specified densities.

Station identification improvements in existing programmes FIXSAF and BA2 are described. These allow the use of informal station names in addition to station numbers.

1. INTRODUCTION

Two innovations have been made to the existing data storage and retrieval system (Bellamy, Lodwick, & Townsend, 1971) used in the BMR Gravity Section.

The first change was introduced to facilitate the plotting and contouring of map sheet areas. Previously the practice had been to take the relevant data (Bouguer anomalies, latitude, longitude, etc.) from the printout of various surveys which covered parts of the map sheet to be drawn up. The new programme LOCATE will quickly check through the magnetic tape library, abstracting all stations which lie between any desired latitude and longitude limits. It computes Bouguer anomalies for a number of densities and lists them together with principal facts, thus eliminating any tedious sorting by the draftsman and reducing the number of runs made on the computer.

The second change arose from the need to renumber private company surveys, during their recomputation with revised datum and scale factors etc. Existing company station numbers are often alpha-numeric, making it time-consuming to sort them into order by computer. The new approach involves a retention of the original number, with a BMR prefix number allotted for facility of handling and filing within BMR.

Such a change is brought about by adjustments to the programmes FIXSAF and BA2 (Bellamy, Lodwick, & Townsend, 1971) and use of programme LOCATE, as described later.

2. INSTRUCTIONS ON PROGRAMME LOCATE

Sample layout

1. JOB card
2. EQUIP, 5 = MT, (BMR GRAV 04), HI, SV, RO
3. LOCATE programme deck
4. RUN card
5. SURVEY AREA FILE NAME card
6. LAT-LONG card
7. 99999
8. SURVEY AREA FILE NAME card
9. AREA card
10. DENSITY card
11. BLANK card
12. EOF card

'Locate' finds all gravity stations lying between the desired latitude-longitude co-ordinates and lists station number, latitude, longitude, elevation, and observed gravity. Cards 1-7 inclusive perform this. However, if Bouguer anomalies are required, cards 8-12 are added, and Bouguer anomalies with up to seven densities are produced. Card 5 is the magnetic tape title as used in GRAVHTS programme (e.g. BUREAU MINERAL RESOURCES PRINCIPAL FACTS INDEX 09). Card 6 defines the maximum and minimum latitude, maximum and minimum longitude, and output title unrestricted in form (e.g. ...2400...2300... 133300...132000.....title). Format is 4(I5,F3.1)4X, 11A4. Card 7 has nines in the first five columns and is a control card. Card 8 is identical with card 5. Card 9 contains the title mentioned in card 6 (e.g. Hermannsburg 1:250,000 area sheet). Card 10 gives a listing of densities from which Bouguer anomalies will be calculated. Format is 7F5.2. Card 11 is completely blank and is a control card. Card 12 is the normal 'end of file' or 7/8 card.

The programme is always equipped 5 equals magnetic tape, read only, and uses the drum as a scratch tape. Programme runs take from 2 to 4 minutes for a tape with 5000 stations on store. Stations lying exactly on the border of an area to be extracted will also be included in the printout.

If informal station names are required in the printout the number of densities available is limited to five, since this programme uses BA2 as a subroutine (see Section 3).

The programme listing is given in Appendix A.

3. INSTRUCTIONS ON INFORMAL STATION IDENTIFICATION IN PROGRAMMES FIXSAF AND BA2

The informal station name, if required, may take any form whatsoever, limited only by the size, which may not be greater than 16 characters. The informal name is stored on magnetic tape at the end of the principal fact listing, in format (A4, 1X, A4, 2F10.2, 2F8.2, 2A8) (giving BMR survey number (decimal point), station number, latitude, longitude, elevation, gravity, and informal station name respectively).

Station identification data are put onto tape by the programme FIXSAF. They are fed in on cards with the station number in the first 8 columns and the informal name in columns 61-76. Other data - latitude, gravity - may be put onto tape using the same card if desired (see FIXSAF for format). The informal name is subsequently extracted by use of the programme BA2. The presence of an informal station name limits the number of densities available for any one programme run to five (as mentioned in the previous section), and is given in the same line as its BMR number and the five Bouguer anomalies. A sample printout is shown in Appendix D.

Card order for FIXSAF

3 Equip cards, 1 = MT, RO, 2 = MT, RW, 3 = mt, RW

1 JOB card

2 FIXSAF programme deck

3 RUN card

4 C/CREATE card, or C/UPDATE, or C/DELETE

5 DATA deck

6 END card

7 SAF card identifying the tape name or survey area file

8 AREA card identifying the area to be dealt with

9 7/8 card

DATA deck and END card are omitted to delete a whole area. To delete one station, that station is included in the data deck with a D in column 9. The number of updates, creates, and deletes performed in any one programme run is limited only by time available on the computer.

See Appendix B for the programme listing.

Bouguer anomalies are computed from the principal facts on magnetic tape by programme BA2. The output from this programme gives a principal fact listing, free-air anomaly, BMR station number, informal station name, and five Bouguer anomalies corresponding to five different densities.

Card order for BA2

1 Equip card 40 = MT, RO

1. JOB card
2. BA2 programme deck
3. RUN card
4. SAF card, as in FIXSAF
5. AREA name
6. DENSITY card, up to 5 densities, FORMAT 7F5.2
7. BLANK card

Multiple runs for Bouguer anomalies are easily made by repeating cards 5 and 6 until computer time limits come into force once again.

See Appendix C for the programme listing.

4. ACKNOWLEDGMENT

Acknowledgment is given to Mr G.D. Lodwick, who gave advice in the programming of LOCATE.

5. REFERENCE

BELLAMY, C.J., LODWICK, G.D., and TOWNSEND, D.G., 1965 - The gravity reductions, storage and retrieval system used by BMR. Bur. Miner. Resour. Aust. Rec. 1971/7 (unpubl.).

```
      PROGRAM LOCATE
      COMMON VLATMAX,VLATMIN,VLONGMAX,VLONGMIN,SMITH(200)
      DIMENSION MABEL(20),LABEL(20),IBIS(11)
   50 READ(60,1050)LABEL
 1050 FORMAT(20A4)
      WRITE(40,1050)LABEL
   54 READ(5,1050)MABEL
      DO 51 N=1,20
      IF(LABEL(N)-MABEL(N))52,51,52
   51 CONTINUE
      WRITE(61,1054)MABEL
 1054 FORMAT(1X,20A4)
      GO TO 57
   52 WRITE(61,1051)MABEL,LABEL
 1051 FORMAT(X,6H TAPE ,20A4,16H LOADED ON LU 5  ,/,11H SHOULD BE ,20A4)
   59 STOP
   57 READ(60,1053)I,VLATMAX,J,VLATMIN,K,VLONGMAX,L,VLONGMIN,IBIS
 1053 FORMAT(4(I5,F3.1),4X,11A4)
      IF(I.EQ.99999)102,70
   70 WRITE(61,101)I,VLATMAX,J,VLATMIN,K,VLONGMAX,L,VLONGMIN,IBIS
  101 FORMAT(16H STATIONS WITHIN,I4,F5.1,4H AND,I4,F5.1,10H LATITUDE,,I5
     1,F5.1,4H AND,I5,F5.1,10H LONGITUDE,8X,20A4)
      WRITE(40,1056)IBIS
 1056 FORMAT(36(1H ),11A4)
      VLATMAX=VLATMAX+I*60.+0.001
      VLATMIN=VLATMIN+J*60.-0.001
      VLONGMAX=VLONGMAX+K*60.+0.001
      VLONGMIN=VLONGMIN+L*60.-0.001
   56 READ(5, 1050)MABEL
      IF(MABEL(1).EQ.4HENDS)58,55
   55 WRITE(61,1052)MABEL
 1052 FORMAT(/,1X,20A4,/)
      CALL EXTRACT
      GO TO 56
   58 REWIND 5
      WRITE(61,1055)
 1055 FORMAT(1H1)
      ENDFILE 40
      GO TO 54
  102 WRITE(40,103)
  103 FORMAT(6HENDSAF)
      REWIND 40
      WRITE(61,1055)
      CALL BA 2
      END
```

```
      SUBROUTINE  EXTRACT
      COMMON VLATMAX,VLATMIN,VLONGMAX,VLONGMIN,SMITH(200)
    6 READ(5,1)ISTN1,ISTN2,ALAT,ALONG,ELEV,GRAV
    1 FORMAT(A4,1X,A4,2F10.2,2F8.2)
      IF(EOF,5)2,3
    3 IF(ALAT.LT.VLATMAX.AND.ALAT.GT.VLATMIN.AND.ALONG.LT.VLONGMAX.AND.A
     1LONG.GT.VLONGMIN)4,6
    4 LAT=ALAT/60
      BLAT= ALAT-LAT*60
      LONG=ALONG/60
      BLONG= ALONG-LONG*60
      WRITE(40,10)ISTN1,ISTN2,ALAT,ALONG,ELEV,GRAV
   10 FORMAT(A4,1H.,A4,2F10.2,2F8.2)
      GRAV = 978000. + GRAV
      WRITE(61,7)ISTN1,ISTN2,LAT,BLAT,LONG,BLONG,ELEV,GRAV
    7 FORMAT(X,A4,1H.,A4,I6,F6.2,I6,F6.2,F10.1,F11.2)
      GO TO 6
    2 RETURN
      END
```

```
      PROGRAM FIXSAF
      DIMENSION ISTAT(2,1000),LAT(1000),LONG(1000),IHT(1000),IGRAV(100
     1,IAREACD(20),ISEG(20),ICDSEG(20),ID(1000)
      DIMENSION LOC1(1000),LOC2(1000)
      REAL LAT,LONG,IHT,IGRAV,LOC1,LOC2
      M=0
      ILK=1
      IN=1
      IOUT=2
    1 READ(60,1001)ICONTROL
      M=M+1
 1001 FORMAT(A4)
 1006 FORMAT(20A4)
 1005 FORMAT(A4,1X,A4,2F10.2,2F8.2)
 1002 FORMAT(A4,1H,,A4,2F10.2,2F8.2)
 1007 FORMAT(6HENDSAF,74X)
      IF(EOF,60)100,119
  119 IF(M.GT.1)120,4
  120 ILK=1-ILK
      IF(ILK.EQ.0)121,122
  121 IN=2
      IOUT=3
      GO TO 4
  122 IN=3
      IOUT=2
      GO TO 4
  100 STOP
    4 IF(ICONTROL.EQ.4HC/DE)9,16
    9 READ(60,1006)ICDSEG
 3003 READ(IN,1006)IAREACD
      IF(IOCHECK,IN)3003,3004
 3004 DO 3000 I=1,20
      IF(ICDSEG(I).EQ.IAREACD(I))3000,3001
 3000 CONTINUE
      GO TO 3002
 3001 GO TO 61
 3002 WRITE(IOUT,1006)IAREACD
      READ(60,1006)ICDSEG
   17 READ(IN,1006)ISEG
      IF(IOCHECK,IN)17,18
   18 IF(ISEG(1).EQ.4HENDS)20,19
   19 DO 11 I=1,20
      IF(ISEG(I).EQ.ICDSEG(I))11,12
   11 CONTINUE
      GO TO 13
   12 WRITE(IOUT,1006)ISEG
   16 READ(IN,1053)ISTN1,ISTN2,ALAT,ALONG,HT,GRAV,LOC1,LOC2
      IF(IOCHECK,IN)16,3005
 3005 IF(EOF,IN)14,15
   15 WRITE(IOUT,1051)ISTN1,ISTN2,ALAT,ALONG,HT,GRAV,LOC1,LOC2
      GO TO 16
   14 ENDFILE IOUT
      GO TO 17
   20 WRITE(61,1020)ICDSEG
 1020 FORMAT(34H SEGMENT TO BE DELETED NOT ON TAPE,2X,20A4)
      WRITE(IOUT,1007)
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```
   27  REWIND IN
       REWIND IOUT
       GO TO 1
    13 READ(IN,1053)ISTN1,ISTN2,ALAT,ALONG,HT,GRAV,LOC1,LOC2
       IF(EOF,IN)21,13
    21 READ(IN,1006)ISEG
       IF(ISEG(1).EQ.4HENDS)23,22
    22 WRITE(IOUT,1006)ISEG
    26 READ(IN,1053)ISTN1,ISTN2,ALAT,ALONG,HT,GRAV,LOC1,LOC2
       IF(EOF,IN)25,24
    25 ENDFILE IOUT
       GO TO 21
    24 WRITE(IOUT,1051)ISTN1,ISTN2,ALAT,ALONG,HT,GRAV,LOC1,LOC2
       GO TO 26
    23 WRITE(IOUT,1007)
       WRITE(61,996)ICDSEQ
   996 FORMAT(5X,20A4,8H DELETED)
       GO TO 27
    10 IF(ICONTROL.EQ.4HC/CR.OR.ICONTROL.EQ.4HC/UP)30,29
    29 WRITE(61,1029)ICONTROL
  1029 FORMAT(38H ILLEGAL CONTROL CARD, COLS 1 TO 4 ARE,2X,A4)
    31 READ(60,1001)ICONTROL
       IF(EOF,60)32,33
    33 IF(ICONTROL.EQ.4HC/CR.OR.ICONTROL.EQ.4HC/UP.OR.ICONTROL.EQ.4HC/DE)
      14,31
    32 STOP
C
    30 K=1
    34 READ(60,1034)ISTAT(1,K),ISTAT(2,K),LATDEG,LATMIN,LATSEC,LONGDEG,LONGMI
      3NGMIN,
      1LONGSEC,IHT(K),IGRAV(K),LOC1(K),LOC2(K)
  1034 FORMAT(2A4,2X,3I2,4X,I3,2I2,F8.1,F10.2,15X,2A8)
       LAT(K)=60.*LATDEG+LATMIN+LATSEC/60.
       LONG(K)=60.*LONGDEG+LONGMIN+LONGSEC/60.
       IF(ISTAT(1,K).EQ.4HEND )38,35
    35 K=K+1
       IF(K-1000)34,34,37
    37 WRITE(61,1037)                                                    1910
  1037 FORMAT(61H NUMBER OF STATIONS IN UPDATING OR CREATING FILE EXCEEDS
      11000 )
       GO TO 1
    36 K=K-1
C*****SORT
       L=K-1
       N=L
       DO 40 I=1,L
       ISWAP=0
       DO 41 J=1,N
       IF(ISTAT(1,J)-ISTAT(1,J+1))41,44,43
    44 IF(ISTAT(2,J)-ISTAT(2,J+1))41,45,43
    43 ITEMP1=ISTAT(1,J)
       ITEMP2=ISTAT(2,J)
       ATEMP3=LAT(J)
       ATEMP4=LONG(J)
       ATEMP5=IHT(J)
       ATEMP6=IGRAV(J)
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      ITEMP7=ID(J)
      ATEMP8=LOC1(J)          $              ATEMP9=LOC2(J)
      ISTAT(1,J)=ISTAT(1,J+1)
      ISTAT(2,J)=ISTAT(2,J+1)
      LAT(J)=LAT(J+1)
      LONG(J)=LONG(J+1)
      IHT(J)=IHT(J+1)
      IGRAV(J)=IGRAV(J+1)
      ID(J)=ID(J+1)
      LOC1(J)=LOC1(J+1)                $          LOC2(J)=LOC2(J+1)
      ISTAT(1,J+1)=ITEMP1
      ISTAT(2,J+1)=ITEMP2
      LAT(J+1)=ATEMP3
      LONG(J+1)=ATEMP4
      IHT(J+1)=ATEMP5
      IGRAV(J+1)=ATEMP6
       ID(J+1)=ITEMP7
      LOC1(J+1)=ATEMP8           $          LOC2(J+1)=ATEMP9
      ISWAP=ISWAP+1
      GO TO 41
   45 WRITE( 61,1045)ISTAT(1,J),ISTAT(2,J)
 1045 FORMAT(17H STATION NUMBER  ,A4,1H.,A4,23H APPEARS MORE THAN ONCE)
   41 CONTINUE                                                          2310
      IF(ISWAP)40,42
   40 N=N-1
C
   42 IF(ICONTROL.EQ.4HC/CR)46,47
   46 READ(60,1006)ICDSEG
 4666 READ(IN,1006)IAREACD
      DO 4046 I=1,20
      IF(ICDSEG(I).EQ.IAREACD(I))4046,4047
 4046 CONTINUE
      GO TO 4048
 4047 WRITE(61,1061)IAREACD,IN,ICDSEG
      GO TO 32
 4048 READ(60,1006)ICDSEG
      WRITE(IOUT,1006)IAREACD
   52 READ(IN,1006)ISEG
      IF(IOCHECK,IN)52,302
  302 WRITE(IOUT,1006)ISEG
      IF(ISEG(1).EQ.4HENDS)50,53
   53 READ(IN,1053)ISTN1,ISTN2,ALAT,ALONG,HT,GRAV,LOC1,LOC2
 1053 FORMAT(A4,X,A4,2F10.2,2F8.2,2A8)
      IF(IOCHECK,IN)53,303
  303 IF(EOF,IN)4049,51
   51 WRITE(IOUT,1051)ISTN1,ISTN2,ALAT,ALONG,HT,GRAV,LOC1,LOC2
 1051 FORMAT(A4,1H.,A4,2F10.2,2F8.2,2A8)
      GO TO 53
 4049 ENDFILE IOUT
      GO TO 52
   50 BACKSPACE IOUT
      WRITE(IOUT,1006)ICDSEG
      PRINT 301
  301 FORMAT(6H 11111)
      DO 54 I=1,K
      IF(LAT(I).EQ.0.)55,56
```

```
   55 BLAT=-99999.00
      GO TO 556
   56 BLAT=LAT(I)
  556 IF(LONG(I).EQ.0.)57,58
   57 BLONG=-99999.00
      GO TO 59
   58 BLONG=LONG(I)
   59 IF(IHT(I).EQ.0.)559,558
  559 HT=-999.00
      GO TO 554
  558 HT=IHT(I)
  554 IF(IGRAV(I).EQ.0.)555,560
  555 GRAV=-999.00
      GO TO 557
  560 GRAV=IGRAV(I)*0.43
  557 WRITE(IOUT,1051)ISTAT(1,I),ISTAT(2,I),BLAT,BLONG,HT,GRAV,LOC1(I),LOC2(I
     1OC2(I)
   54 WRITE(61,1059)ISTAT(1,I),ISTAT(2,I),BLAT,BLONG,HT,GRAV,LOC1(I),LOC2(I)
     22(I)
 1059 FORMAT(X,A4,1H.,A4,8F10.2,2F8.2,2X,2A8)
      ENDFILE IOUT
      WRITE(IOUT,1007)
      REWIND IN
      REWIND IOUT
      WRITE(61,1060)ICDSEG,IOUT
 1060 FORMAT(9H SEGMENT ,20A4,20H CREATED ON TAPE LU ,I3)
      GO TO 1
C**** UPDATE
   47 READ(60,1006)ICDSEG
   62 READ(IN,1006)IAREACD
      DO 60 I=1,20
      IF(ICDSEG(I).EQ.IAREACD(I))60,61
   61 WRITE(61,1061)IAREACD,IN,ICDSEG
 1061 FORMAT(X,6HTAPE  ,20A4,14H LOADED ON LU ,I3,/,X,11HSHOULD BE  ,
     120A4)
      GO TO 32
   60  CONTINUE
      WRITE(IOUT,1006)IAREACD
      READ(60,1006)ICDSEG
      IFOUND=0
      WRITE(61,1062)IAREACD,ICDSEG
 1062 FORMAT(1H1,X,32H DATA USED TO UPDATE TAPE NAME  ,/,X,20A4,//,27H F
     1ILE ON TAPE UPDATED NAMED,X,20A4)
   71 READ(IN,1006)ISEG
      WRITE(IOUT,1006)ISEG
      IF(ISEG(1).EQ.4HENDS)63,64
   63 IF(IFOUND-1)66,65
   66 WRITE(61,1066)ICDSEG,IAREACD
 1066 FORMAT(X,50(1H*),5HAREA ,20A4,16HNOT ON SAF FILE ,20A4)
   65 WRITE(61,1065)IOUT
 1065 FORMAT(X,13HLOGICAL UNIT ,I3,3X,21HIS LATEST OUTPUT TAPE)
      REWIND IN
      REWIND IOUT
      GO TO 1
C
   64 DO 67 J=1,20
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      IF(ICDSEG(J).EQ.ISEG(J))67,68
   67 CONTINUE
      IFOUND=1
      GO TO 72
   68 READ(IN,1053)ISTN1,ISTN2,NLAT,ALONG,ELEV,GRAVITY,LOC1,LOC2
      IF(EOF,IN)70,69
   69 WRITE(IOUT,1051)ISTN1,ISTN2,ALAT,ALONG,ELEV,GRAVITY,LOC1,LOC2
      GO TO 68
   70 ENDFILE IOUT
      GO TO 71
C
   72 IEND=IR=0
      KTR=0
   73 KTR=KTR+1
       IF(KTR.GT.K)117,74
   74 IF(IEND.EQ.1)83,77
   77 READ(IN,1053)ISTN1,ISTN2,NLAT,ALONG,ELEV,GRAVITY,LOC1,LOC2
      IF(EOF,IN)78,79
   78 IEND=1
       GO TO 83
   79 IF(ISTN1-ISTAT(1,KTR))81,82,83
   82 IF(ISTN2-ISTAT(2,KTR))81,84,83
   84 IF(ID(KTR).EQ.1HD)73,86
   86 IF(LAT(KTR).EQ.0.)87,88
   88 BLAT=LAT(KTR)
      GO TO 91
   87 BLAT=ALAT
   91 IF(LONG(KTR).EQ.0)89,90
   90 BLONG=LONG(KTR)
      GO TO 92
   89 BLONG=ALONG
   92 IF(IHT(KTR).EQ.0.)94,93
   93 HT=IHT(KTR)
      GO TO 944
   94 HT=ELEV
  944 IF(IGRAV(KTR).EQ.0)96,95
   95 GRAV=IGRAV(KTR)
      GO TO 97
   96 GRAV=GRAVITY
   97 WRITE(IOUT,1051)ISTN1,ISTN2,BLAT,BLONG,HT,GRAV,LOC1(KTR),LOC2(KTR)
      GO TO 73
C     NO NUMBER IN CORE TO UPDATE NUMBER ON TAPE
   81 WRITE(IOUT,1051)ISTN1,ISTN2,ALAT,ALONG,ELEV,GRAVITY,LOC1,LOC2
      GO TO 74
C     NO NUMBER ON TAPE FOR NUMBER IN CORE
   83 IF(LAT(KTR).EQ.0.)101,102
  101 BLAT=-99999.00
      GO TO 103
  102 BLAT=LAT(KTR)
  103 IF(LONG(KTR).EQ.0)104,105
  104 BLONG=-99999.00
      GO TO 106
  105 BLONG=LONG(KTR)
  106 IF(IHT(KTR).EQ.0.)107,108
  107 HT=-999.00
      GO TO 109
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```
      108 HT=IHT(KTR)
      109 IF(IGRAV(KTR).EQ.0.)110,111
      110 GRAV=-999.00
          GO TO 112
      111 GRAV=IGRAV(KTR)
      112 WRITE(IOUT,1051)ISTAT(1,KTR),ISTAT(2,KTR),BLAT,BLONG,HT,GRAV,
         1LOC1(KTR),LOC2(KTR)
          KTR=KTR+1
          IF(KTR.GT.K)113,114
      113 IR=1
          IF(IEND.EQ.1)115,116
      114 IF(IEND.EQ.1)83,79
      117 READ(IN,1053)ISTN1,ISTN2,ALAT,ALONG,ELEV,GRAVITY,LOC1,LOC2
          IF(EOF,IN)115,116
      116 WRITE(IOUT,1051)ISTN1,ISTN2,ALAT,ALONG,ELEV,GRAVITY,LOC1,LOC2
          GO TO 117
      115 ENDFILE IOUT
          GO TO 71
          END
```

```
      PROGRAM BA2
      INTEGER ERRORS,PAGE,LCOUNT,IENDSAF,BFLAG,NDCR
      REAL STN1,STN2,LAT,LONG,EL,OGRAV,DCR
      INTEGER HCR,HMT
      INTEGER ACR,AMT
      COMMON HCR(20),HMT(20)
      COMMON ACR(20),AMT(20)
      COMMON ERRORS,PAGE,LCOUNT,IENDSAF(20),BFLAG
      COMMON STN1,STN2,LAT,LONG,EL,OGRAV,LOC1,LOC2
      COMMON DCR(5),DCRB(5),NDCR
      REAL FA,FAB
      REAL DCRB
      REAL BA,BAB
      DIMENSION BA(5),BAB(5)
      REAL BLANK
      INTEGER IBLANK
      DIMENSION IBLANK(2)
      EQUIVALENCE(BLANK,IBLANK)
      COMMON BLANK
      DATA(DUMP=6HDUMP,)
      REWIND 40
      IENDSAF(1)=4HENDS
      IENDSAF(2)=4HAF
      DO 18 I=3,20
   18 IENDSAF(I)=4H
   30 ERRORS=0
      LCOUNT=0
      PAGE=0
      IBLANK(1)=4H
      IBLANK(2)=4H
C**** CHECK MAG TAPE LABEL=CARD LABEL
      READ(60,41)HCR
   41 FORMAT(20A4)
   50 READ(40,41)HMT
      DO 62 I=1,20
      IF(HCR(I)-HMT(I))70,62,70
   62 CONTINUE
      GO TO 90
   70 PAGE=PAGE+1
      WRITE(61,71)PAGE,HMT,HCR
   71 FORMAT(1H1,6H PAGE ,I3
     1/1X,36H HEADERS ON MT AND CR ARE DIFFERENT
     2/1X,14H MT HEADER IS                    ,20A4,
     3/1X,14H CR HEADER IS ,20A4 )
      STOP
C**** READ AREA AND DENSITY CARDS
   90 READ(60,91)ACR,DCR
   91 FORMAT(20A4,/,5F5.2)
      IF(EOF,60)100,200
C**** END OF DATA ROUTINE
  100 PAGE=PAGE+1
      WRITE(61,101)PAGE,HCR,ACR
  101 FORMAT(1H1,////,6H PAGE ,I3,10X,20A4,/1X,20A4//)
      WRITE(61,111)ERRORS
  111 FORMAT(1X,26H NUMBER OF ERRORS FOUND =  ,I3)
      WRITE(61,121)
```

```
  121 FORMAT(1X,////,11H END OF JOB                )
      WRITE(59,121)
      REWIND 40
      RETURN
C**** ENCODE BLANKS INTO DENSITY ARRAY
  200 DO 204 I=1,5
      IF(DCR(I)=0.0)202,205,202
  202 ENCODE(8,203,DCRB(I))DCR(I)
  203 FORMAT(F8.2)
  204 NDCR=I
      GO TO 208
  205 DO 207 J=I,5
      ENCODE(8,206,DCRB(J))
  206 FORMAT(8X)
  207 CONTINUE
  208 PAGE=PAGE+1
      WRITE(61,209)PAGE,HCR,ACR,DCRB
  209 FORMAT(1H1,////,6H PAGE ,I3,10X,20A4,/1X,20A4/2X,
     162HSTATION   LOCATION                    LATITUDE   LONGITUDE ELEVATION
     221H    GRAVITY  FREE AIR,5X,31HDENSITIES AND BOUGUER ANOMALIES
     310H (MGAL)   /32X,43H(DEG  MIN)  (DEG  MIN)    (FEET)     (MGAL)
     410H    (MGAL),5(2X,R8))
      LCOUNT=8
C*****SEARCH FOR AREA
  210 READ(40,41)AMT
  220 DO 222 I=1,20
      IF(AMT(I)=IENDSAF(I))230,222,230
  222 CONTINUE
      REWIND 40
      GO TO 300
  230 DO 232 I=1,20
      IF(ACR(I)=AMT(I))240,232,240
  232 CONTINUE
      GO TO 250
  240 CALL SKIP(40)
      GO TO 210
  250 READ(40,251)STN1,STN2,LAT,LONG,EL,OGRAV,LOC1,LOC2
  251 FORMAT(A8,A1,2F10.2,2F8.2,2A8)
      IF(EOF,40)90,260
  260 CALL BASUB2
      GO TO 250
C*****SECOND PASS
  300 READ(40,301)HMT
  301 FORMAT(20A4)
C
  310 READ(40,301)AMT
  320 DO 323 I=1,20
      IF(AMT(I)=IENDSAF(I))430,323,430
  323 CONTINUE
      GO TO 330
  430 DO 432 I=1,20
      IF(ACR(I)=AMT(I))440,432,440
  432 CONTINUE
      GO TO 250
  440 CALL SKIP(40)
      GO TO 310
```

```
C**** ERROR ROUTINE
  330 WRITE(61,331)ACR
  331 FORMAT(1X,1X,16H AREA NOT ON MT
     1/1X,17H AREA FROM CR IS ,20A4)
      CALL Q8QERROR(0,DUMP)
      REWIND 40
      GO TO 50
      END
```

```
      SUBROUTINE BASUB2
      INTEGER ERRORS,PAGE,LCOUNT,IENDSAF,BFLAG,NDCR
      REAL STN1,STN2,LAT,LONG,EL,OGRAV,DCR
      INTEGER HCR,HMT
      INTEGER ACR,AMT
      COMMON HCR(20),HMT(20)
      COMMON ACR(20),AMT(20)
      COMMON ERRORS,PAGE,LCOUNT,IENDSAF(20),BFLAG
      COMMON STN1,STN2,LAT,LONG,EL,OGRAV,LOC1,LOC2
      COMMON DCR(5),DCRB(5),NDCR
      REAL FA,FAB
      REAL DCRB
      REAL BA,BAB
      DIMENSION BA(5),BAB(5)
      REAL BLANK
      INTEGER IBLANK
      DIMENSION IBLANK(2)
      EQUIVALENCE(BLANK,IBLANK)
      COMMON BLANK
      INTEGER IFA,IFB
      INTEGER LATD,LONGD
      REAL LATM,LONGM
      REAL LAT1,LAT2,NGRAV,K
      BFLAG=0
      IFA=0
      IFB=0
      IF(LAT+99999.0)5,1,1
    1 IF(LONG+99999.0)6,2,2
    2 IF(EL+9999.0)7,3,3
    3 IF(OGRAV+9999.0)8,20,20
    5 ERRORS=ERRORS+1
      BFLAG=1
      IFA=1
      GO TO 1
    6 ERRORS=ERRORS+1
      IFB=1
      GO TO 2
    7 ERRORS=ERRORS+1
      BFLAG=1
      GO TO 3
    8 ERRORS=ERRORS+1
      BFLAG=1
      GO TO 20
   20 FAB=BLANK
      DO 22 I=1,5
   22 BAB(I)=BLANK
   30 IF(IFA)35,34,35
   34 LAT=LAT/60.0
   35 IF(IFB)37,36,37
   36 LONG=LONG/60.0
   37 IF(BFLAG.EQ.1)60,40
   40 LAT1=LAT*3.1415926536/180.0
      LAT2=2.0*LAT1
      NGRAV=978049.0*
     1(1.0+0.0052884*SIN(LAT1)*SIN(LAT1)
     2-0.0000059*SIN(LAT2)*SIN(LAT2))
```

```
  3-978000,0
   K=EL*0,012770
   DGRAV=OGRAV-NGRAV
   FA = DGRAV + EL*0,09406
50 DO 55 I=1,NDCR
52 BA(I)=       FA-K*DCR(I)
   ENCODE(8,54,FAB)FA
   ENCODE(8,54,BAB(I))BA(I)
54 FORMAT(F8,2)
55 CONTINUE
60 IF(LCOUNT-60)70,61,61
61 PAGE=PAGE+1
   WRITE(61,62)PAGE,HCR,ACR,(DCRB(I),I=1,5)
62 FORMAT(1H1,////,6H PAGE ,I3,10X,20A4,/1X,20A4/2X,
  162HSTATION   LOCATION                    LATITUDE   LONGITUDE ELEVATION
  221H    GRAVITY  FREE AIR,5X,31HDENSITIES AND BOUGUER ANOMALIES
  310H (MGAL)   /32X,43H(DEG  MIN)  (DEG  MIN)    (FEET)      (MGAL)
  410H    (MGAL),5(2X,R8))
   LCOUNT=8
70 IF(IFA)72,71,72
71 LATD=IFIX(LAT)
   LATM=(LAT-LATD)*60,0
   LATM=ABSF(LATM)
   GO TO 75
72 LATD=900000
   LATM=900000000,
   GO TO 75
75 IF(IFB)77,76,77
76 LONGD=IFIX(LONG)
   LONGM=(LONG-LONGD)*60,0
   LONGM=ABSF(LONGM)
   GO TO 80
77 LONGD=900000
   LONGM=900000000,
80 IF(OGRAV+9000,0)82,81,81
81 OGRAV=OGRAV+978000,0
82 WRITE(61,83)
  1STN1,STN2,LOC1,LOC2,LATD,LATM,LONGD,LONGM,EL,OGRAV,
  2FAB,(BAB(I),I=1,5)
83 FORMAT
  1(X,A8,A1,2X,2A8,2X,2(2X,I4,X,F5,2),2X,F8,1,X,F10,2,6(2X,R8))
   LCOUNT=LCOUNT+1
   RETURN
   END
```

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MAGELLAN 1960

STATION	LOCATION		LATITUDE (DEG MIN)	LONGITUDE (DEG MIN)	ELEVATION (FEET)	GRAVITY (MGAL)	FREE AIR (MGAL)	DENSITIES AND BOUGUER ANOMALIES (MGAL) 1,90	2,20	2,40	2,67	3,00
6106.6767		67-67	23 48,65	133 29,15	2046,2	978636,38	-60,03	-109,68	-117,52	-122,74	-129,80	-138,42
6106.7223	116	72-23	24 20,63	133 26,82	1590,7	978741,70	-33,29	-71,89	-77,98	-82,05	-87,53	-94,23
6106.7224		72-24	24 16,67	133 25,58	1643,3	978728,48	-37,11	-76,98	-83,28	-87,47	-93,14	-100,06
6106.7225		72-25	24 13,10	133 28,07	1766,6	978704,08	-45,90	-88,76	-95,53	-100,04	-106,13	-113,58
6106.7226	87	72-26	24 10,93	133 30,55	1789,0	978697,04	-48,40	-91,81	-98,66	-103,23	-109,40	-116,94
6106.7227		72-27	24 7,07	133 32,58	1866,6	978685,76	-48,06	-93,35	-100,50	-105,26	-111,70	-119,57
6106.7228		72-28	24 4,58	133 34,85	1958,1	978672,71	-49,72	-97,23	-104,73	-109,73	-116,48	-124,73
6106.7229	58	72-29	24 2,30	133 37,23	1957,6	978665,77	-54,16	-101,65	-109,15	-114,15	-120,90	-129,15
6106.7230		72-30	23 59,30	133 40,55	1925,5	978662,10	-57,50	-104,22	-111,60	-116,51	-123,15	-131,27
6106.7231	38	72-31	23 55,87	133 44,33	1953,9	978655,89	-57,22	-104,63	-112,11	-117,10	-123,84	-132,07
6106.7232		72-32	23 52,37	133 47,50	1836,1	978653,40	-66,90	-111,45	-118,48	-123,17	-129,50	-137,24
6106.7233	18	72-33	23 48,83	133 50,72	1798,6	978647,58	-72,32	-115,96	-122,85	-127,45	-133,65	-141,23
6131.0001	1		23 42,77	133 52,50	1888,3	978646,27	-58,49	-104,31	-111,54	-116,36	-122,87	-130,83
6131.0002	2		23 43,05	133 52,32	1882,1	978648,30	-57,35	-103,02	-110,23	-115,03	-121,52	-129,46
6131.0003	3		23 43,42	133 52,02	1873,6	978649,92	-56,94	-102,40	-109,58	-114,36	-120,82	-128,72
6131.0004	4		23 43,92	133 51,52	1865,3	978650,32	-57,87	-103,13	-110,28	-115,04	-121,47	-129,33
6131.0005	5		23 44,42	133 51,55	1859,6	978650,27	-59,01	-104,13	-111,26	-116,01	-122,42	-130,25
6131.0006	6		23 44,60	133 51,93	1852,5	978652,27	-57,88	-102,83	-109,92	-114,65	-121,04	-128,85
6131.0007	7		23 45,22	133 52,08	1844,6	978654,90	-56,68	-101,43	-108,50	-113,21	-119,57	-127,34
6131.0008	8		23 45,68	133 52,15	1838,2	978656,33	-56,36	-100,96	-108,00	-112,70	-119,03	-126,78
6131.0009	9		23 46,05	133 52,20	1830,8	978655,10	-58,69	-103,12	-110,13	-114,80	-121,12	-128,83
6131.0010	10		23 46,50	133 52,32	1820,2	978654,80	-60,49	-104,65	-111,63	-116,28	-122,55	-130,22
6131.0011	11		23 47,15	133 52,43	1811,2	978654,12	-62,74	-106,68	-113,62	-118,25	-124,49	-132,12
6131.0012	12		23 47,55	133 52,18	1804,5	978654,45	-63,48	-107,26	-114,17	-118,78	-125,00	-132,61
6131.0013	13		23 47,83	133 51,85	1802,2	978653,77	-64,69	-108,41	-115,32	-119,92	-126,13	-133,73
6131.0014	14		23 48,20	133 51,52	1796,2	978651,58	-67,85	-111,43	-118,31	-122,90	-129,09	-136,66
6131.0015	15		23 48,45	133 51,13	1793,4	978650,90	-69,07	-112,58	-119,45	-124,03	-130,22	-137,77
6131.0016	16		23 47,55	133 52,38	1801,8	978654,58	-63,60	-107,32	-114,22	-118,82	-125,04	-132,63
6131.0017	17		23 47,97	133 52,67	1793,9	978654,16	-65,23	-108,76	-115,63	-120,21	-126,40	-133,96
6131.0019	19		23 49,12	133 50,33	1802,2	978646,02	-73,86	-117,59	-124,50	-129,10	-135,31	-142,91
6131.0020	20		23 49,48	133 50,07	1797,7	978648,07	-72,64	-116,25	-123,14	-127,73	-133,93	-141,51
6131.0021	21		23 49,67	133 49,75	1793,6	978650,44	-70,86	-114,38	-121,25	-125,83	-132,02	-139,58
6131.0022	22		23 50,13	133 49,47	1795,9	978650,54	-71,06	-114,63	-121,51	-126,10	-132,29	-139,86
6131.0023	23		23 50,43	133 49,20	1794,8	978650,88	-71,15	-114,70	-121,58	-126,16	-132,35	-139,91
6131.0024	24		23 50,75	133 48,92	1790,3	978651,98	-70,83	-114,27	-121,13	-125,70	-131,87	-139,42
6131.0025	25		23 51,13	133 48,58	1806,8	978651,77	-69,91	-113,75	-120,67	-125,29	-131,52	-139,13
6131.0026	26		23 51,48	133 48,27	1817,2	978651,86	-69,23	-113,32	-120,28	-124,92	-131,19	-138,85
6131.0027	27		23 51,83	133 47,98	1829,0	978652,05	-68,32	-112,70	-119,70	-124,37	-130,68	-138,39
6131.0028	28		23 52,18	133 47,67	1829,9	978653,13	-67,54	-111,94	-118,95	-123,63	-129,94	-137,65
6131.0029	29		23 52,52	133 47,37	1841,8	978653,54	-66,39	-111,08	-118,14	-122,84	-129,19	-136,95
6131.0030	30		23 52,97	133 46,98	1879,2	978652,64	-64,27	-109,87	-117,07	-121,87	-128,35	-136,27
6131.0031	31		23 53,47	133 46,57	1856,0	978655,83	-63,82	-108,85	-115,96	-120,70	-127,10	-134,92
6131.0032	32		23 53,83	133 46,25	1872,6	978656,00	-62,49	-107,92	-115,10	-119,88	-126,34	-134,23
6131.0033	33		23 54,18	133 45,93	1884,9	978656,28	-61,44	-107,18	-114,40	-119,21	-125,71	-133,65
6131.0034	34		23 54,53	133 45,63	1898,8	978656,47	-60,33	-106,40	-113,68	-118,53	-125,07	-133,08
6131.0035	35		23 54,87	133 45,30	1926,4	978655,70	-58,89	-105,63	-113,01	-117,93	-124,57	-132,69
6131.0036	36		23 55,23	133 44,97	1930,9	978656,25	-58,31	-105,16	-112,56	-117,49	-124,15	-132,28
6131.0037	37		23 55,57	133 44,60	1932,6	978656,75	-58,03	-104,92	-112,32	-117,26	-123,92	-132,07
6131.0039	39		23 56,25	133 43,92	1975,4	978655,35	-56,16	-104,09	-111,66	-116,70	-123,51	-131,84
6131.0040	40		23 56,58	133 43,57	1993,6	978654,87	-55,30	-103,67	-111,30	-116,40	-123,27	-131,67
6131.0041	41		23 56,92	133 43,27	2008,2	978654,99	-54,18	-102,91	-110,60	-115,73	-122,65	-131,12
6131.0042	42		23 57,23	133 42,93	2030,4	978654,58	-52,85	-102,11	-109,89	-115,08	-122,08	-130,63

APPENDIX D