UNITED STATES DEPARTMENT OF INTERIOR

U.S. Geological Survey

MARK3B Mineral Assessment Program for Macintosh

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Open-File Report 98-356

DRAFT

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Reston, Virginia
6/98

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Introduction

The US Geological Survey conducts mineral-resource assessments at a variety of scales to provide land and resource managers with information about the types of mineral deposits that are present in an area, the parts of the area that are permissive for the occurrence of additional mineral deposits, and estimates of the amounts of undiscovered mineral resources. Basic concepts and the form of these mineral-resource assessments are described by Singer (1993).

If sufficient data are available for a study area and appropriate grade and tonnage models for particular types of mineral deposits are available, estimates of numbers of mineral deposits can be combined with grade and tonnage data by a Monte Carlo simulation to produce probability distributions of quantities of contained metal and rock for the study area. These distributions can be used to provide mineral information for land-use planning and long-term resource supply. These estimates also provide a basis for subsequent economic analysis to determine the potential value, if any, of undiscovered mineral resources.

The programs on this disc are designed to use a Monte Carlo simulation to combine estimates of the numbers and types of undiscovered deposits into probabilistic estimates of the amounts of undiscovered metals. The basic data, from which the programs run, are tables of sizes and grades of known deposits of many different types. Each such table is called a deposit model.

After an estimator has determined the types of deposits that might be present in an area, the next step is to estimate the number of each type of deposit. The estimate of the number of deposits is given by specifying several quantiles of a probability distribution. For example, the 90% quantile is the largest number of deposits for which the estimator believes that the probability of that many or more deposits being present is 0.9 or more. Similarly for the other quantiles: 50%, 10%, 5%, 1%, 0.5%, 0.1%, 0.05%, and 0.01% Once an estimator has determined at least the 90%, 50%, and 10% quantiles of the probability distributions for the number of deposits for each deposit type present, the estimator is then ready to run the simulator, MARK3B. The output of such a run is probability distributions of quantities of each metal that appears in at least one of the deposit models.

Notes about MARK3B for Macintosh

This version of MARK3B was compiled on a Macintosh 9500/132 with 128mb RAM running Mac O/S 7.5.5 using MPW Shell 3.4.2b1 and LS Fortran 1.2 by Fortner Research The source code file is "mark3b.f".

The fortran code was modified from MARK3B written in Green Hills Fortran-88000, Revision 1.8.6.1 running on a Data General Aviion DG/UX 5.4.3.1 UNIX computer.

Running MARK3B Simulation Program

To run MARK3B, the "bem" files for the models must be in the same directory as the executable program. In the following worked example, user responses are in italics. The model numbers refered to in MARK3 are listed on page 11. The user can print them out from within MARK3B. Only 113 models are available at this time. This program is intended for use only with these models. If the user wishes to add to or modify the models, refer to the PC version of MARK3 (Root et al, 1997).

Launch one of the following executables:
- Power Mac computers - mark3b
- Older Macs with 68000 series chips - mark3b68k

MARK3 CAN BE RUN VIA KEYBOARD ENTRY OR FROM
A PRE-PREPARED SCRIPT.
ENTER "S" TO READ A SCRIPT (INPUT FILE).
ENTER "Q" TO QUIT.
OTHERWISE PRESS C/R TO CONTINUE WITH KETYBOARD INPUT:

ENTER "M" TO DISPLAY A LISTING OF THE AVAILABLE MODELS.
ENTER "Q" TO END PROGRAM.
OTHERWISE PRESS C/R TO CONTINUE:

NEED A LISTING OF DATA WITH MODEL/METAL IDS?
ENTER "P" TO CREATE A PRINTABLE FILE
ENTER "Q" TO END PROGRAM.
OTHERWISE PRESS C/R TO CONTINUE:

PLEASE TYPE INFORMATION FOR IDENTIFICATION OF YOUR RESULTS -
REQUESTED BY:
John Doe
ASSESSMENT AREA:
Area1
DATE REQUESTED:
6/29/1998

DO YOU WANT GRAND TOTALS OR TRACT TOTALS?
IN EMPIRICAL MODE, BOTH METHODS GIVE TONNES METAL AND ROCK FOR EACH MODEL.
IN LOGNORMAL MODE, BOTH METHODS GIVE ONLY TONNES ROCK.

GRAND TOTALS SUM ALL THE MODELS IN THE RUN.
TRACT TOTALS ALLOW YOU TO SUBTOTAL ON GROUPS OF MODELS (TRACTS).
FOR INSTANCE:
TRACT 1 = MODEL 6 + MODEL 7
TRACT 2 = MODEL 8 + MODEL 9

```
TRACT TOTALS METHOD DOES NOT GIVE A GRAND TOTAL FOR ALL THE MODELS IN A
RUN.

ENTER "G" (GRAND) OR "T" (TRACT):
g

WOULD YOU LIKE A "SHELL SCRIPT" CREATED ? (Y/N)


ENTER A SEED (AN INTEGER FROM 1 TO 9999)
OR PRESS C/R FOR "987" DEFAULT:


ENTER TOTAL NUMBER OF ESTIMATES (MODELS) FOR THIS RUN:
1

YOU WILL BE PROMPTED FOR EACH MODEL ON A SEPARATE LINE.
USE THE FOLLOWING FORMAT.
FOR INSTANCE:
   TRACT 1 = MODEL 6 + MODEL 7
   TRACT 2 = MODEL 8 + MODEL 9
WOULD BE ENTERED AS:
   6
   7 * TR01
   8
   9 * TR02

ENTER SINGLE MODEL(INDEX) NUMBER:
6

ENTER UNIQUE FILE NAME FOR MARK3B OUTPUT RESULTS:
m6o

ENTER UNIQUE FILE NAME FOR MARK3B OUTPUT RESULTS
REFORMATTED FOR SPREADSHEET PARSING (EXCEL TEMPLATE):
m6f

TERMINAL INPUT FOR MODEL   6 - PORPHYRY MO, LOW-F(21B)
enter 4 character ID#:
tr01

ENTER  "L"  FOR LOGNORMAL
ENTER  "E"  FOR EMPIRICAL
e

ENTER LEVEL OF PRECISION OF YOUR ESTIMATE
(3,5, OR 9 ESTIMATES):
3

ENTER ESTIMATED NUMBER OF DEPS.(1-3):
 90%    50%    10%
ND(2)  ND(3)  ND(4)

90% =
1
50% =
2
10% =
```

```
3

TO FIX THE PROBABILITY OF ZERO DEPOSITS,
ENTER A PROBABILITY BETWEEN 0. & 1.
OR ENTER -1. FOR DEFAULT.
.5

TERMINAL INPUT COMPLETE.

ALLOW 3 MINUTES FOR EACH MODEL -
THIS RUN WILL TAKE APPROX.   3 MINUTES.
(DEPENDS GREATLY ON VALUES ENTERED)

SORRY, NO PROGRESS BAR IS AVAILABLE FOR THIS PROGRAM.

FORMATTING FILES...

  1 - PROCESSING MODEL(INDEX)   6 -  EMPIRICAL
MOLY6.BEM

xpected mean MOLYBDENUM                1.74667E+05      3.67183E+05
xpected mean TONNES                    2.18666E+08      4.59677E+08
LUDFMT ROUTINE
II=            6
1.74667E+05      3.67183E+05
2.18666E+08      4.59677E+08
iuc=             2
iuclp=             3
987          1          6         6o          6f          r01
1          2          3           0.5000000
  FILE CREATED IS - m6o
  reformatted file is - m6f

END OF PROCESSING.
YOU CAN EXAMINE YOUR OUTPUT FILES NOW OR
SELECT THE FILE MENU, RERUN PROGRAM.
```

The results of this run are in output file "m6o" which follows:

```
                    MARK3B SIMULATION RESULTS

                   (EXPRESSED IN METRIC TONS)

               REQUESTED BY:      John Doe

            ASSESSMENT AREA:      Area1

             DATE REQUESTED:      6/29/1998
         6 - PORPHYRY MO, LOW-F(21B)
         EMPIRICAL (  1,  2,  3) SEED=  987
         Probability of Zero Deposits=  0.5000000


        SORTED SIMULATION RESULTS FOR MOLYBDENUM
```

ORDER OF OCCURRENCE

	UNCONDITIONAL		CONDITIONAL
1	0.00000E+00	2622	1.64211E+03
250	0.00000E+00	2740	2.37006E+04
500	0.00000E+00	2859	3.81408E+04
750	0.00000E+00	2978	5.30818E+04
1000	0.00000E+00	3097	6.97608E+04
1250	0.00000E+00	3216	8.66332E+04
1500	0.00000E+00	3335	1.07314E+05
1750	0.00000E+00	3454	1.28349E+05
2000	0.00000E+00	3573	1.48686E+05
2250	0.00000E+00	3692	1.78080E+05
2500	0.00000E+00	3811	2.02216E+05
2750	2.49836E+04	3929	2.34751E+05
3000	5.59113E+04	4048	2.75921E+05
3250	9.24365E+04	4167	3.23490E+05
3500	1.35053E+05	4286	3.81840E+05
3750	1.91031E+05	4405	4.61261E+05
4000	2.58328E+05	4524	5.73120E+05
4250	3.62338E+05	4643	7.32735E+05
4500	5.38383E+05	4762	9.72809E+05
4750	9.46216E+05	4881	1.28168E+06
4875	1.26311E+06	4940	1.69500E+06
4950	1.77556E+06	4976	2.01515E+06
4999	3.38178E+06	4999	3.38178E+06
	EXPECTED MEAN MOLYBDENUM		
	1.74667E+05		3.67183E+05

N= 0	FREQ(N)=	2621	PROB(N)= 0.5000
N= 1	FREQ(N)=	565	PROB(N)= 0.1250
N= 2	FREQ(N)=	1039	PROB(N)= 0.2143
N= 3	FREQ(N)=	774	PROB(N)= 0.1607

MEAN NUMBER OF DEPOSITS 0.9932

SORTED SIMULATION RESULTS FOR TONNES

ORDER OF OCCURRENCE

	UNCONDITIONAL		CONDITIONAL
1	0.00000E+00	2622	1.85880E+06
250	0.00000E+00	2740	2.79413E+07
500	0.00000E+00	2859	4.58241E+07
750	0.00000E+00	2978	6.30346E+07
1000	0.00000E+00	3097	8.54093E+07
1250	0.00000E+00	3216	1.08297E+08
1500	0.00000E+00	3335	1.31336E+08
1750	0.00000E+00	3454	1.57626E+08
2000	0.00000E+00	3573	1.79694E+08
2250	0.00000E+00	3692	2.09261E+08

2500	0.00000E+00	3811	2.42260E+08
2750	2.94788E+07	3929	2.78295E+08
3000	6.69407E+07	4048	3.17959E+08
3250	1.14163E+08	4167	3.83336E+08
3500	1.65134E+08	4286	4.54008E+08
3750	2.23795E+08	4405	5.68015E+08
4000	3.00908E+08	4524	7.87833E+08
4250	4.35350E+08	4643	1.04554E+09
4500	7.31293E+08	4762	1.31872E+09
4750	1.28969E+09	4881	1.71738E+09
4875	1.69695E+09	4940	1.83780E+09
4950	1.87544E+09	4976	2.05738E+09
4999	3.55291E+09	4999	3.55291E+09
	EXPECTED MEAN TONNES		
	2.18666E+08		4.59677E+08

N= 0	FREQ(N)=	2621	PROB(N)= 0.5000
N= 1	FREQ(N)=	565	PROB(N)= 0.1250
N= 2	FREQ(N)=	1039	PROB(N)= 0.2143
N= 3	FREQ(N)=	774	PROB(N)= 0.1607

MEAN NUMBER OF DEPOSITS 0.9932

USER INPUT

```
SEED     # OF MODELS    MODEL        OUTPUT      REFORMATTED
          IN REQUEST   NUMBER(S)    FILE NAME    FILE NAME

    4CHAR.MODEL   [E]MPIRICAL   #OF EST. # OF   EST # OF
PROB.-
    DESCRIPTION   [L]OGNORMAL   DEPS. 3,5,OR9   DEPOSITS   ZERO
```

THE FOLLOWING ORDER OF FIELDS IS CORRECT
BUT THE WRAP-AROUND WILL BE DIFFERENT FROM
THE ABOVE HEADER WRAP-AROUND.

```
 987           1            6          m6o          m6f
tr01        E          3             1            2
 3            0.5000000
```

Batch Operation

Entering keyboard responses to MARK3B prompts can be very laborious. MARK3B can also read and write scripts which can be modified in a text editor such as BBEdit. The modified script can be used to quickly evaluate other tracts. The script from the worked example above follows. The explanations for each line are in parenthesis:

```
 # /bin/sh                 (for DG UNIX compatibility only)
mark3b <<:::> /dev/null (for DG UNIX compatibility only)
 X                         (list avail models?)
 X                         (list of data w/ model/metal ID's?)
 John Doe                  (requested by?)
 Area1                     (area name?)
 6/29/1998                 (date requested?)
G                          (grand totals or tract totals?)
 N                         (create a shell script?)
 987                       (start seed for random num generator)
   1                       (total num of models this run?)
   6                       (model number, porphyry moly)
m6o                        (output file name)
m6f                        (output file name for formatted data)
tr01                       (four character ID?)
E                          (lognormal or empirical?)
3                          (3, 5, or 9 estimates?)
  1                        (90% confidence)
  2                        (50% confidence)
  3                        (10% confidence)
   0.5000000               (probability of zero deposits)
:::                        (end of file mark)
```

Notes about MARK3B

At the second prompt in MARK3B the user is allowed to print out the list of available models. The number to the left of the model name is the code used in the MARK3B program. The code to the right of the model name refers to the identification of the model in (Cox and Singer eds.,1986)

```
INDEX     TITLE(COX-SINGER MODEL #)    # of DEPOSITS * FILE
 1   HOMESTAKE AU(36B)                       118-* HOMESTAKE1
     DAN L. MOSIER
 2 P-PORPHYRY CU-MO(21A)                      16-* PORPHCM2
     DON A. SINGER, DENNIS P. COX, DAN L. MOSIER
 3 P-EPIGENETIC VEIN BARITE(27E)              37-* EVNBAR3
     GRETA J. ORRIS
 4 P-PORPHYRY COPPER(17)                     208-* PORPHCU4
     DON A. SINGER, DAN L. MOSIER, DENNIS P. COX
 5   STOCKWORK(CLIMAX) MO(16)                  9-* CLIMAXMO5
     DON A. SINGER, TED G. THEODORE, DAN L. MOSIER
 6   PORPHYRY MO, LOW-F(21B)                  29-* MOLY6
     W. DAVID MENZIE, TED G. THEODORE
 7   FE SKARN(18D)                           170-* FESKARN7
     DAN L. MOSIER, W. DAVID MENZIE
 8   COPPER SKARN(18B)                        64-* CUSKARN8
     GAIL M. JONES, W. DAVID MENZIE
 9 P-PORPHYRY CU, SKARN RELATED(18A)          18-* PCURELAT9
     DON A. SINGER
10 P-TUNGSTEN TRIOXIDE SKARN(14A)             36-* WSKARN10
     W. DAVID MENZIE, GAIL M. JONES
11   CYPRUS MASSIVE SULFIDE(24A)              49-* CYPRUSMS11
     DON A. SINGER, DAN L. MOSIER
12   VOLCANOGENIC U(25F)(06/06/91)            21-* VOLCANU12
     DAN L. MOSIER
13   SEDIMENTARY EXHALATIVE ZN-PB(31A)        42-* SEDEX13
     W. DAVID MENZIE, DAN L. MOSIER
14   MARINE BEDDED GYPSUM(35A.5)              12-* MBEDG14
     GRETA J. ORRIS
15   CARB-HOSTed AU-AG(26A)(TO 01/15/91)      35-* CHGOLD15
     WILLIAM C. BAGBY, W.D.MENZIE, D.L.MOSIER, D.A.SINGER
16   COMSTOCK EPITHERMAL VEINS(25C)           41-* COMSTOCK16
     DAN L. MOSIER, TAKEO SATO, DON A. SINGER
17   SEDIMENT-HOST. AU(26A.1)(UPD 01/16/91)   39-* SEDHOST17
     WILLIAM C. BAGBY, W.D.MENZIE, D.L.MOSIER, D.A.SINGER
18   DISTAL DISSEMINATED AG-AU(19C)           10-* DISTALD18
     DENNIS P. COX, DON A. SINGER
19   SYNOROGENIC AND SYNVOLCANIC NI-CU(7A)    32-* SYNORVOL19
     DON A. SINGER, NORM J. PAGE, W. DAVID MENZIE
20   ALKALINE-HOSTED AU(22B)                  20-* ALKHAU20
     DENNIS P. COX, WILLIAM C. BAGBY
21 P-MIXED BASE & PRECIOUS METAL VEINS        23-* MXBASE21
     JIM BLISS
22   ZN-PB SKARN(18C)                         35-* LZSKARN22
     DAN L. MOSIER
23 P-BEDDED BARITE(31B)                       43-* BBARITE23
     GRETA J. ORRIS
```

24	TUNGSTEN TRIOXIDE VEINS(15A)	18-*	WVEINS24
	GAIL M. JONES, W. DAVID MENZIE		
25	Qz-Adularia-Combo of 28&16(OCT 15, 93)	61-*	QZADULRIA25
	STEVE LUDINGTON REQUEST TO COMBINE 28 & 16		
26	CHUGACH L-SULF AU-Q V(36A.1)(01/16/91)	29-*	CHUGACHLS26
	JAMES D. BLISS		
27	L. SULF AU-QZ VEINS(36A)(TO 01/15/91)	411-*	LWSULF27
	JAMES D. BLISS		
28	SADO EPITHERMAL VEIN(25D)	20-*	SADOEV28
	DAN L. MOSIER, TAKEO SATO		
29	HOT SPRINGS HG(27A)	20-*	HSPRINGHG29
	JAMES J. RYTUBA, DON A. SINGER		
30	BESSHI MASSIVE SULFIDE(24B)	44-*	BESSHIMS30
	DON A. SINGER		
31	REPLACEMENT MN(19B)	37-*	REPMN31
	DAN L. MOSIER		
32	P-BEACH PLACERS(39C)	61-*	BEACHPL32
	EMIL D. ATTANASI, JOHN H. DEYOUNG, JR.		
33	SEDIMENTARY MN(34B)	16-*	SMANG33
	DAN L. MOSIER		
34	P-PORPHYRY CU-AU(20C)	40-*	PORCUAU34
	DON A. SINGER, DENNIS P. COX		
35	LATERITIC NI(38A)	71-*	LATNI35
	DON A. SINGER		
36	OOLITIC IRONSTONES(34F)	45-*	OOLITIC36
	ORRIS, G.J.		
37	LATERITE-SAPROLITE AU(38G)	10-*	LATSAP37
	JAMES D. BLISS		
38	EPITHERMAL QZ-AL VEINS(25E)	9-*	EPQALOW38
	DAN L. MOSIER, W. DAVID MENZIE		
39	P-SOLUTION-COLLAPSE BRECCIA PIPE U(32E)	8-*	SCBRECCIA39
	WARREN I. FINCH		
40	RHYOLITE-HOSTED SN(25H)	132-*	RHOSTSN40
	DON A. SINGER, DAN L. MOSIER		
41	KARST TYPE BAUXITE(38C)	41-*	KARSTB41
	DAN L. MOSIER		
42	S.E. MO PB-ZN(32A)&APPALCHIAN ZN(32B)	20-*	SCARB42
	DAN L. MOSIER, JOSEPH A. BRISKEY		
43	PLUTONIC PORPHYRY GOLD(20D.1)	2-*	PORPHAU43
	DICK MCCAMMON		
44	SIERRAN KUROKO MASSIVE SULFIDE(28A.1)	23-*	SIERRAN44
	DON A. SINGER		
45	HOT SPRINGS AU-AG(25A)(UPDATED-1987)	17-*	HOTSPRNG45
	BRYON R. BERGER, DON A. SINGER		
46	POLYMETALLIC VEINS(22C)	75-*	POLYVEIN46
	JAMES D. BLISS, DENNIS P. COX		
47	POLYMETALLIC REPLACEMENT(19A)	53-*	POLYR47
	DAN L. MOSIER,HAL T. MORRIS,D. A. SINGER		
48	SN SKARN(14B)	8-*	SKARN48
	W. DAVID MENZIE, BRUCE L. REED		
49	SN REPLACEMENT(14C)	6-*	RPLACEM49
	W. DAVID MENZIE, BRUCE L. REED		
50	SN GREISEN(15C)	12-*	GREISEN50
	W. DAVID MENZIE, BRUCE L. REED		
51	SN VEINS(15B)	42-*	VEINS51
	W. DAVID MENZIE, BRUCE L. REED		
52	POLYMETALLIC VEIN-KENO HILL(BORA)	33-*	PVEINKH52
	DICK MCCAMMON		

53	(CARBONATITE) Rare Earth Element(10) DON A. SINGER	20-*	CARBREE53
54	P-PLACER AU-PGE NATOMAS-Cu CANYON(39A) GRETA J. ORRIS, JAMES D. BLISS	46-*	PLACER54
55	THorium-R.E. ELEMENTS(11C)(TO 01/15/91) JAMES D. BLISS	7-*	TVEIN55
56	SIMPLE SB(27D) JAMES D. BLISS, GRETA J. ORRIS	81-*	SIMPSB56
57	TH-R.E. VEINS(11C.1)(UPDATED 01-16-91) JAMES D. BLISS	32-*	THREV57
58	CREEDE EPITHERMAL VEINS(25B) DAN L. MOSIER, TAKEO SATO, DON A. SINGER	27-*	CREEDE58
59	PRECIOUS METAL VEINS	8-*	PMVEINS59
60	IRREGULAR REPLACEMENT	21-*	IREPLACE60
61	SN SHEETED VEINS	16-*	SHEETEDV61
62	REPLACED WITH # 26 NOV. 1, 1993 JIM BLISS	29-*	DISCNTINUD
63	SEDIMENT-HOSTED CU(30B) DAN L. MOSIER,D. A. SINGER,DENNIS P. COX	61-*	SHOSTCU63
64	SEDIMENT-HOST. CU(KOOTENAI Natl.Frst.) GREG SPANSKI	12-*	SHOSTCU64
65	SERPENTINE-HOSTED ASBESTOS(8D) GRETA J. ORRIS	64-*	SERPHABS65
66	KOMATIITIC NI-CU(6A) DON A. SINGER,NORM J. PAGE,W. D. MENZIE	31-*	KOMATNC66
67	CUBAN-TYPE VOLCANOGENIC MN(24C.2) DAN L. MOSIER, NORMAN J. PAGE	122-*	CUBANVMN67
68	UPWELLING-TYPE PHOSPHATE(34C) DAN L. MOSIER	60-*	PHOSUPW68
69	UNCONFORMITY U-AU(37A) DAN L. MOSIER	36-*	UNCONUAU69
70	LATERITE-TYPE BAUXITE(38B) DAN L. MOSIER	71-*	LATBAUX70
71	DUNITIC NI-CU(6B) DON A. SINGER, NORM J. PAGE	22-*	DUNNICU71
72	FRANCISCIAN-TYPE VOLCNOGNIC MN(24C.1) DAN MOSIER	237-*	FRANCVMN72
73	CYPRUS-TYPE VOLCANOGENIC MN(24C.4) DAN MOSIER	42-*	CYPVOLMN73
74	EPITHERMAL MN(25G) DAN L. MOSIER	59-*	EPITHMN74
75	SILICA-CARBONATE HG(27C) JAMES J. RYTUBA, SIMON M. CARGILL	28-*	SILCARBHG75
76	SANDSTONE-HOSTED PB-ZN(30A) DAN L. MOSIER	20-*	SANDPBZN76
77	SUPERIOR FE & ALGOMA FE(34A) DAN L. MOSIER, DON A. SINGER	66-*	SUPERFE77
78	WARM-CURRENT TYPE PHOSPHATE(34D) DAN L. MOSIER	18-*	WARMCPH78
79	OLYMPC PENSULA TYPE VLCNGNIC-MN(24C.3) DAN MOSIER	17-*	OLYPENMN79
80	AU-AG-TE VEINS(22B) JAMES D. BLISS & OTHERS	24-*	AATVEINS80
81	PORPHYRY CU(17)(N. AMERICAN SUBSET)	107-*	PORPHCU81

82		GOLD-BEARING SKARNS(INCLUDES FE & PB)	90-*	AUSKARN82
		T.G. THEODORE,G.J. ORRIS,J.M. HAMMARSTROM,J.D. BLISS		
83		LACUSTRINE BORATES	23-*	LBORATE83
		GRETA ORRIS		
84		FE SKARN <15MT(18D.1)	108-*	FESKARN84
		DAN L. MOSIER, W. DAVID MENZIE		
85		FE SKARN <200MT(18D.2)	153-*	FESKARN85
		DAN L. MOSIER, W. DAVID MENZIE		
86		FE SKARN <40MT(18D.3)	129-*	FESKARN86
		DAN L. MOSIER, W. DAVID MENZIE		
87		AMORPHOUS GRAPHITE(18K)	31-*	AMGRAPH87
		DAVID SUTPHIN		
88		DISSEMINATED FLAKE GRAPHITE(37F)	88-*	DFGRAPH88
		DAVID SUTPHIN		
89		BC/AK PRPHRY CU(17.1)(ALaSKA)(2/26/93)	56-*	BAPORCU89
		DON A. SINGER, W. DAVID MENZIE		
90		GOLD-BEARING SKARNS(W/O FE & PB)	90-*	AUSXFEPB90
		T.G. THEODORE,G.J. ORRIS,J.M. HAMMARSTROM,J.D. BLISS		
91		MINOR PODIFORM CR(8A)	435-*	MINORPCR91
		DONALD A. SINGER, NORM P. PAGE		
92		POLY. REPL.(19A) & ZN-PB SKARN(18C)	88-*	POLYSKARN92
		DAN L. MOSIER OTHERS ?		
93		KUROKO MASSIVE SULFIDE(28A)	433-*	KUROKOMS93
		DONALD A. SINGER, DAN L. MOSIER		
94	?	MINOR MVT(32AB)	10-*	MINORMV94
		NEED TO INSERT AUTHOR		
95	?	AU-SB OF 93-194	49-*	SBAUDEP95
		NEED TO INSERT AUTHOR		
96	?	REDUCED-FACIES SEDIMENT-HOSTED CU	45-*	REDFAC96
		Dave Lindsey		
97	?	REDBED COPPER	17-*	REDBEDCU97
		NEED TO INSERT AUTHOR		
98		BESSHI MASSIVE SLFID.(24B.1)(10/27/93)	41-*	BESSMS98
		JOHN SLACK		
99		MICHIGAN NATIVE COPPER DEPOSITS	12-*	MICHCU99
		BILL CANNON(12/06/93)		
100		HOMESTAKE(#1 Modified) DEPOSITS XLS	30-*	HOMEXLS100
		NEED TO INSET AUTHOR		
101		ARCHEAN LODE AU DEPOSITS XLS	150-*	ARCHXLS101
		NEED TO INSET AUTHOR		
102		SDIMNT-HST CU,RDUD FACIES(noCU-#96Mod)	21-*	RFACMOD102
		NEED TO INSET AUTHOR		
103		KUROKO PRECAMBRIAN ONLY	188-*	KUROPRE103
		NEED TO INSET AUTHOR		
104		KUROKO PHANEROZOIC	244-*	KUROPHAN104
		NEED TO INSET AUTHOR		
105		AU-BEARING SKARNS(#82 mod)	63-*	AUSKMOD105
		NEED TO INSET AUTHOR		
106		SEDIMENTARY EXHAULATIVE ZN(#13 mod)	42-*	SEZNMOD106
		NEED TO INSET AUTHOR		
107		PRYOR MOUNTAINS URANIUM-VANADIUM	38-*	PRYORM107
		NEED TO INSET AUTHOR		
108		MISSISSIPPI VALLEY(#42 update)	20-*	MISSVAL108
		NEED TO INSET AUTHOR		
109		Mississippi Valley(no Missouri)	18-*	MISSVMOD109
		Dennis Cox		
110		NW Nevada-distal disseminated Au-Ag	17-*	NWNEVDD110
		(ted theodore ?)		

111	BLUE MOUNTAIN - POLYMETALIC VEINS (greg spanski ?)	16-*	BLUEMNT111
112	Tungsten Trioxide Skarn - NEVADA Jim Bliss	114-*	WSKRNNV112
113	Rio Grande Rift Pb-Zn Dave Sutphin, V.T. McLemore	3-*	RIOGRND113

--- MODEL 113 IS THE LAST AVAILABLE MODEL ---

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Appendix A (from Open-File Report 93-280)

The complete report on disk can be obtained from
USGS Information Services
Box 25046, MS 517
Denver, CO 80225
Phone: 303-202-4210

This disk contains data files of the grades and tonnages of mineral deposits that were used to construct grade and tonnage models presented in Cox and Singer (1986), Mosier and Page (1988), and Bliss (1992). A total of 3310 deposits grouped into 50 different types of mineral deposits are included. The purpose of this publication is to make this information available in digital form. Many of the data sets have been previously published in paper form (Berger and Singer, 1992; Cox and Singer, 1992; Mosier, and others, 1983; Mosier, and others, 1986a; Mosier, and others, 1986b; Mosier, and others, 1992; Menzie and Mosier, 1985; Menzie and others 1988; Menzie and others, 1992; Menzie and Singer, 1993; Singer and others, 1980; Singer, 1992; Theodore and Menzie, 1983). A mineral deposit is a mineral occurrence of sufficient size and grade that it might, under the most favorable circumstances, be considered to have economic potential (Cox, and others, 1986). Deposits sharing a relatively wide variety and large number of attributes come to be characterized as a "type," and a model representing that type can evolve.

Grade and tonnage models of mineral deposits are useful in quantitative resource assessments and exploration planning. Construction of grade and tonnage models involves multiple steps (Singer, in press), the first of which is the identification of a group of well-explored deposits that are believed to belong to the mineral deposit type being modeled. A descriptive model is commonly prepared as well, and the attributes of each deposit in the group are compared with it to ensure that all are of the same type. Data gathered for each deposit include average grades of each metal or mineral commodity of possible economic interest and the associated tonnage based on the total production, reserves, and resources at the lowest possible cutoff grade. All further references to tonnage follow this definition. All tonnages reported here are in millions of metric tonnes. Grades not available (always for by-products) are treated as zero. Country codes are listed in a separate file.

An important consideration at the data gathering stage is the question of what the sampling unit should be. Grade and tonnage data are available to varying degrees for districts, deposits, mines, and shafts. For the most part the data included here represent individual deposits, but in some instances such data are mixed with data representing districts. In addition, for some of the deposit types, a special rule was used to determine which ore bodies were combined. For example, ore bodies of both kuroko and Cyprus type massive sulfides were combined into single deposits based on a 500-m rule of adjacency (Mosier and others, 1983). Information about such rules is available in the references listed below.

Several of the data sets have had a few deposits added (for example, kuroko) or have had a small number of the grades or tonnages changed from data used in published models by recent information (for example, kuroko, Sierran kuroko, Homestake). Five deposits were removed from the kuroko and Sierran kuroko models because of questions about their correct classification. In no case should these modifications result in significantly different summary statistics than those presented in Appendix B in Cox and Singer (1986) or in Singer (1993).

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