UNITED STATES DEPARTMENT OF INTERIOR

GEOLOGICAL SURVEY

Pb-isotope data base for sulfides from Alaska, March, 1987

by

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This report is preliminary and has not been edited or reviewed for conformity with U. S. Geological Survey standards and nomenclature. Any use of trade names is for descriptive purposes only and does not imply endorsement by the USGS.

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INTRODUCTION

The Pb-isotope data base for sulfide deposits in Alaska has come about in conjunction with the Alaska Mineral Resource Appraisal Program (AMRAP), and is a direct outgrowth of the USGS "Common-Pb in sulfides from Alaska" project. An extensive body of Pb-isotope data exists for the Canadian Cordillera (e.g. Godwin and others, 1982; Godwin and Sinclair, 1982) and for the North American Cordillera, but few previous determinations have been made of the numerous sulfide occurrences within Alaska. We have started gathering sulfide samples and anticipate analyzing up to 100 samples per year. We will concentrate in areas where the results will have the maximum impact on the assessment of the mineral endowment and geologic history of Alaska. We solicit the cooperation of geologists working in Alaska in the collection of well-documented samples for this project (see Appendix II). The primary objectives of the project are three-fold:

1.) to utilize Pb-isotope signatures, in conjunction with the regional mapping, to assess the relative ages and categorize the types of deposits studied,

2.) to relate the Pb-isotope and trace-element geochemical signatures of specific deposit and occurrences to ore-forming processes, and

3.) to use these data to correlate tectonostratigraphic terranes within the Cordillera.

PRESENTATION OF THE DATA

The data presented in Tables 1-6 represent the work completed on the project through March 1, 1987. The deposits are grouped by 1° x 3° quadrangle, and the state of Alaska is divided up into the six regions used in other regional data compilations by the U. S. Geological Survey (Figure 1). All abbreviations used in the data tables are documented in Appendix I. Mining regions and district names defined by the U. S. Bureau of Mines (Ransome and Kerns, 1954) have also been used throughout this report (Figure 2). Many of the deposits are briefly described by Berg and Cobb (1967); no attempt will be made in this report to summarize the voluminous literature on ore deposits that has been published since then.

Deposit Information

Information on each specific deposit or occurrence has been provided largely by the sample contributor (Contr.) on a form previously used in this project. However, the information on deposit characteristics has been assembled by S. E. Church, either from the information provided by the contributor or taken from the literature.
Figure 1: Regions of Alaska used in this report. Tables 1-6 give the analytical results for each region. Table 1: NORTHERN ALASKA, Table 2: WEST-CENTRAL ALASKA, Table 3: EAST-CENTRAL ALASKA, Table 4: SOUTHERN ALASKA, Table 5: SOUTHWESTERN ALASKA, Table 6: SOUTHEASTERN ALASKA.
Figure 2. Mining regions and districts of Alaska (Ransome and Kerns, 1954). Abbreviations used in Tables 1-6 are defined in Appendix I; subdistricts are not included.
Contributors were given the opportunity to modify the descriptive data in the tables prior to publication. This process should have minimized errors. Blanks in the tables indicate a lack of information. The deposit classification used in this report is based on the recent compilation by Cox and Singer (1986) and is included here only for the purpose of dialogue. Certainly, there will not be widespread agreement amongst geologists on the classification of deposits into model types! We solicit any new information that knowledgeable readers might have on the classification of specific deposits that we have studied.

Geologic information on the deposit also has been obtained either from the sample contributor or from published literature. The sample source indicates whether the sample came from outcrop, core, dump, and so forth. The deposit characteristics are short summaries (limited to three words) which describe the host rock, structure, and texture of the deposit. Veins are characterized as predominantly calcite or quartz veins in the texture column and the sulfides are disseminated within the gangue minerals of the vein. Formation names have not been used, but the assemblage of rocks containing the deposit have been designated using the tectonostratigraphic terranes (TST) defined by Monger and Berg (1984) for southeastern Alaska (Table 6), and by Jones and others (1984) for the rest of Alaska. The reader is referred to these publications for detailed geologic and stratigraphic information on these rock assemblages. Abbreviations for the TST units are given in Appendix I.

Chemistry and Mass Spectrometry

Most of the Pb-isotope data presented in Tables 1-6 have been analyzed by M. H. Delevaux in the U. S. Geological Survey, Branch of Isotope Geology laboratories. However, there are isolated data published in other sources; these data have been included here for the sake of completeness. Pb-isotope data from the studies of whole-rock Pb, largely from Cenozoic volcanic rocks, have not been included in this data base. References to the whole-rock Pb data are cited in the Pb-isotope bibliography for Alaska. All of the results from references published since 1978 have been made using the silica-gel emitter method. These data have all been corrected for thermal fractionation using the NBS SRM-981 common-Pb standard (Catanzaro and others, 1968) and are accurate, at the 2 sigma level, to within ± 0.1 % or better. All new data reported here have a precision of 0.08 % better. Triple-filament analyses from reference 79.1 have a reported accuracy of 0.1 % per mass unit. Analyses reported in reference 70.1 were determined using the PbS method and were normalized to the CIT reference Pb value. These data have been corrected for thermal fractionation (Doe and Rohrbough, 1979) and have an uncertainty of about 0.15 % per mass unit. Older data from reference 60.1 were determined using the PbI method and are much less precise as no standards were run during that time period to correct for fractionation. Analytical results from reference 60.1 are enclosed in parentheses. Analyses done by Teledyne during the late 1970's have been shown to contain analytical errors (refs 80.1 and
Pb-isotopic determinations have been made largely on sulfides. We report analyses from two types of samples: analyses made on those that contain galena (indicated by GN in the sample mineralogy column) and analyses on either mixed sulfides or on other discrete sulfide phases. Where mixed sulfides have been analyzed, we have given the Pb concentration in the sample determined either by d.c.-arc emission spectrography or in the solution used for Pb-isotopic analysis using atomic absorption spectrophotometry. Previous studies of mixed sulfides, or of separate sulfide minerals that have 100 ppm or more of Pb, indicate that the Pb-isotopic data obtained from this type of sample are comparable to that obtained from galena (e.g. Church and others, 1986; ref 86.5).

Several different chemical procedures have been used on special samples analyzed in this study. In general, galenas have been hand-picked for analysis where possible. Galena samples were prepared for analysis by digestion with ultrapure hot HCl. The sample was purified by precipitation in concentrated HNO₃ (Delevaux and others, 1966), followed by electrodeposition on a platinum electrode from a very dilute HNO₃-HClO₄ solution at 1.8 volts, d.c.. Mixed sulfides were digested in hot ultrapure aqua regia, the solution was decanted and converted first to the chloride medium and then to the bromide medium. Lead was isolated from other cations using anion column exchange in the bromide medium; ultrapure reagents were used throughout the procedure. Blanks were in the subnanogram range and are negligible. The sample was loaded on the resin in 0.75M HBr, washed with 0.75M HBr and then with 1.5M HCl. The Pb was then eluted with 0.3M HNO₃-0.025M HBr. Molybdenites were prepared by digestion in hot ultrapure 6M HCl. A white precipitate, probably Mo₃Cl₄(OH)₂.2H₂O, formed; the Pb remained in solution. Pb was purified by anion exchange in the HBr medium. High-antimony sulfides required special preparation because Sb is also adsorbed on the anion exchange resin in the HBr procedure described above. J. E. Gray has developed a chemical separation procedure that results in separation of most of the Sb from Pb in solution. We have applied this procedure to all our high-Sb solutions prior to loading on the anion exchange columns for final separation of Pb in the bromide medium. All Pb samples obtained from the column separation procedure were then electroplated as described above prior to mass spectrometric analysis.

The isotopic composition of Pb determined at the U. S. Geological Survey, Denver, Co., (Tables 1-6) was done on a 30.5 cm, 68° sector, solid-source mass spectrometer of NBS design. Duplicate analyses were made for all but one sample. Samples were run using the single Re-filament, silica-gel emitter technique at 1200 ± 20° C (Cameron and others, 1969). Two sets of eight ratio pairs for ²⁰⁶Pb/²⁰⁴Pb and one
set each of eight ratio pairs for $^{207}\text{Pb}/^{206}\text{Pb}$ and for $^{208}\text{Pb}/^{206}\text{Pb}$ are taken over a period of 30 to 40 minutes in a typical analysis. Blanks in the data table indicate that the analytical work has not been completed. Analytical results can be expected from these samples in the next 12-18 months. Published data are indicated and the reference given using a year and reference # code (e.g., 70.1 indicates the first reference in the Pb-isotope bibliography for Alaska published in 1970, etc.). Unpublished results are included here for information only and will be published formally in interpretative manuscripts. Permission to use these data in other manuscripts should be obtained by writing S. E. Church.

ACKNOWLEDGMENTS

Research in the U. S. Geological Survey, particularly in Alaska, is a team effort. Certainly, we have not visited all of the deposits or occurrences from which we have analyzed samples. Many geologists who have worked or are now doing field studies in Alaska have contributed samples to this project. We could not conduct this survey without the contributions made by many who have visited mineralized areas in the field. To them, we express our thanks for providing samples and field information about each occurrence. Their efforts are acknowledged individually in the data tables; you are encouraged to contact them if you wish further information on a particular sulfide occurrence. Finally, I thank Bruce Doe for providing Pb-isotope data from several sulfide samples analyzed by the USGS in the late 70's. Samples analyzed under his project (BD) are noted in the data tables in the analyst column (e.g., HS/BD).

REFERENCES CITED


### Table 1. Pb-isotope data from sulfides from Northern Alaska

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<th>Locality</th>
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<th>$^{207}$Pb</th>
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Table 1. Pb-isotope data from sulfides from Northern Alaska (cont.)

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<td>32c</td>
<td>NW/Ki</td>
<td>AAE</td>
<td>D</td>
<td>YJ</td>
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| MD/BD  | O      | granite                | Pb-MTV | 22c | SP/Pc | 86 Ma | 86 Ma | D6 |
| MD/BD  | O      | granite                | Pb-MTV | 22c | SP/Pc | 86 Ma | 86 Ma | D6 |
| MD      | O      | granite                | Pb-MTV | 22c | SP/Pc | 86 Ma | 86 Ma | D6 |

| MD      | P      | m/sd-hstd stringers    | Pb-MTV | 22c | SP/Co | K | K | JB |
| MD      | P      | grndiorite gossan      | Pb-MTV | 22c | SP/Co | K | K | JB |

| MD      | D      | marl-hstd stratabound replac? | Replc? | 19a?/31a? | SP/Co | Pz | Pz? | B6 |
| MD      | O      | monzonite stringer      | Pb-MTV | 22c | SP/Co | K | K | JB |
| MD      | R      | mvol-hstd breccia       | Pb-MTV | 22c | SP/Co | K | K | JB |
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| MD      | R      | marl-hstd shear zn      | Pb-MTV | 22c | SP/Fh | K | K | JB |
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Table 3. Pb-isotope data from sulfides from East-Central Alaska (cont.)

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### Table 4. Pb-isotope data from sulfides from Southern Alaska

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Table 4. Pb-isotope data from sulfides from Southern Alaska (cont.)

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Table 4. Pb-isotope data from sulfides from Southern Alaska (cont.)

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Table 4. Pb-isotope data from sulfides from Southern Alaska (cont.)

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Table 4. Pb-isotope data from sulfides from Southern Alaska (cont.)

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<td>Ba Cu 23</td>
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<td>WR</td>
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ALH O                  | m/vol-hstd stratiform    | K-VMS 28a   | WR/Tk          | Yt/Jc           | YR/1L B7.3              |     |
| ALH O                  | m/vol-hstd stratiform    | K-VMS 28a   | WR/Tk          | Yt/Jc           | YR/1L B7.3              |     |
| ALH O                  | m/vol-hstd stratiform    | K-VMS 28a   | WR/Tk          | Yt/Jc           | YR/1L B7.3              |     |
| ALH O                  | m/vol-hstd stratiform    | K-VMS 28a   | WR/Tk          | Yt/Jc           | YR/1L B7.3              |     |
| MD R                  | m/vol-hstd stratiform    | K-VMS 28a   | WR/Tk          | Yt/Jc           | D D JK B7.3             |     |
| MD O                  | m/vol-hstd stratiform    | K-VMS 28a   | WR/Tk          | Yt/Jc           | SLC B7.3                |     |
| MD O                  | m/vol-hstd stratiform    | K-VMS 28a   | WR/Tk          | Yt/Jc           | SLC B7.3                |     |
| ALH O                  | m/vol-hstd stratiform    | K-VMS 28a   | WR/Bf          | Yt/Hg           | YR/1L                   |     |
| ALH O                  | carb-hstd contact replac | skn 18?     | YR/Dr          | WR/Sr           | IpZ YR/1L               |     |
| ALH O                  | carb-hstd contact replac | skn 18?     | YR/Dr          | WR/Sr           | IpZ YR/1L               |     |
| ALH O                  | m/vol-hstd qz vein       | Pm MTV 22c  | CS/V1          | WR/Sr           | Tr YR/1L                |     |
| ALH O                  | gndiorite massive        | Porp 21a    | CS/Cc          | WR/Sr           | YR/1L                   |     |
| O gabbro               | podiform cumulate        | Stwtr 1     | YR/Dr          | WR/Sr           | Tr Tr YR/1L             |     |
| O gabbro               | podiform cumulate        | Stwtr 1     | YR/Dr          | WR/Sr           | Tr Tr YR/1L             |     |
| O gabbro               | podiform cumulate        | Stwtr 1     | YR/Dr          | WR/Sr           | Tr Tr YR/1L             |     |
| O gabbro               | shearn zn vein           | Stwtr 1     | YR/Dr          | WR/Sr           | Tr Tr YR/1L             |     |
| O gabbro               | shearn zn vein           | Stwtr 1     | YR/Dr          | WR/Sr           | Tr Tr YR/1L             |     |
| O diorite              | lens dissemin            | Porp 21a    | YR/Dr          | WR/Sr           | J-K J-K YR/1L           |     |
| O diorite              | lens dissemin            | Porp 21a    | YR/Dr          | WR/Sr           | J-K J-K YR/1L           |     |
| O m/sd-hstd shearn zn  | qz vein mV               | YR/Dr       | WR/Sr           | Ip-P K? YR/1L    |     |
| O qz diorite stockwork | qz vein mV               | YR/Dr       | WR/Sr           | J-K J-K YR/1L    |     |
| O volc-hstd            | qz vein mV               | CS/Cc       | WR/Tg           | Tr K? YR/1L     |     |
| O serpentine lens      | vein Stwtr 1             | YR/Dr       | WR/Tg           | Tr Tr YR/1L     |     |
| O serpentine lens      | vein Stwtr 1             | YR/Dr       | WR/Tg           | Tr Tr YR/1L     |     |
| O serpentine lens      | vein Stwtr 1             | YR/Dr       | WR/Tg           | Tr Tr YR/1L     |     |
| ALH O                  | m/vol-hstd crs-cutting   | qz vein mV  | CS/V1          | WR/Tg           | K? YR/1L                |     |
| O carb-hstd contact replac | Cu skn 18b       | CS/V1       | WR/Tg           | K 125 Ma YR/1L  |     |
| O carb-hstd contact replac | Cu skn 18b       | CS/V1       | WR/Tg           | K 125 Ma YR/1L  |     |
| O carb-hstd contact replac | Cu skn 18b       | CS/V1       | WR/Tg           | K 125 Ma YR/1L  |     |
Table 5. Pb-isotope data from sulfides from Southwestern Alaska

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Table 5. Pb-isotope data from sulfides from Southwestern Alaska (cont.)

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SKAGWAY

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|                     | Mt. Henry Clay         | DY 3043    | 59 22    | 136 25    | sl, py, cp | 18.924| 15.589| 38.281|
|                     | Glacier Creek          | BL-1       | 59 24    | 136 23    | py, cp, tt, mt, sl, gn | 18.417| 15.421| 38.049|

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**Table 6. Pb-isotope data from sulfides from Southeastern Alaska (cont.)**
Pb-isotope Bibliography for Alaska

1960

1970

1978

1979

1980

1982
1983


1984


1985


3) LeHuray, A. P., Church, S. E, and Nokleburg, W. J., 1985, Lead isotopes in sulfide deposits from the Jarvis Creek Glacier and Wrangellia Terranes, Mount Hayes Quadrangle, eastern


1986


1987


APPENDIX I

Summary of abbreviations used in Tables 1-6

Sample Mineralogy

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<th>Symbol</th>
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Sample source

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Deposit Characteristics (abbreviations underlined)

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| Structural terms      |                                           |                                            |
| breccia               |                                           |                                            |
| ign. contact          |                                           |                                            |
| shear zone            |                                           |                                            |
| stratiform            |                                           |                                            |
| concordant            |                                           |                                            |
| lens                  |                                           |                                            |
| sheeted-dike          |                                           |                                            |
| stringer              |                                           |                                            |
Textural terms

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**DEPOSITS RELATED TO SUBAERIAL MAFIC EXTRUSIVE ROCKS**

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**DEPOSITS RELATED TO MARINE MAFIC EXTRUSIVE ROCKS**

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**DEPOSITS RELATED TO SUBAERIAL FELSIC TO MAFIC EXTRUSIVE ROCKS**

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### DEPOSITS HOSTED IN CARBONATE ROCKS

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<th>Description</th>
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<tbody>
<tr>
<td>SEM Pb-Zn</td>
<td>32a</td>
<td>SE Missouri Pb-Zn</td>
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<tr>
<td>Apl Zn</td>
<td>32b</td>
<td>Appalachian Zn</td>
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<tr>
<td>Kip Cu</td>
<td>32c</td>
<td>Kipushi Cu-Pb-Zn</td>
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### CHEMICAL-SEDIMENTARY DEPOSITS

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<tr>
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<tr>
<td>sd Mn</td>
<td>34a</td>
<td>Superior Fe</td>
</tr>
<tr>
<td></td>
<td>34b</td>
<td>Sedimentary Mn</td>
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<tr>
<td></td>
<td>34c</td>
<td>Upwelling-type phosphate deposits</td>
</tr>
<tr>
<td></td>
<td>34d</td>
<td>Warm-current-type phosphate deposits</td>
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### DEPOSITS RELATED TO REGIONAL METAMORPHISM

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<tr>
<td>mAu-V</td>
<td>36a</td>
<td>Low-sulfide Au-Quartz veins</td>
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<tr>
<td>Home</td>
<td>36b</td>
<td>Homestake Au</td>
</tr>
<tr>
<td></td>
<td>37a</td>
<td>Unconformity U-Au</td>
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<tr>
<td></td>
<td>37b</td>
<td>Au on flat faults</td>
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### DEPOSITS RELATED TO SURFICIAL PROCESSES AND UNCONFORMITIES

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<td>Plc Au</td>
<td>39a</td>
<td>Placer Au-PGE</td>
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<tr>
<td></td>
<td>39b</td>
<td>Placer PGE-Au</td>
</tr>
<tr>
<td></td>
<td>39c</td>
<td>Shoreline placer Ti</td>
</tr>
<tr>
<td></td>
<td>39d</td>
<td>Diamond Placers</td>
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<tr>
<td></td>
<td>39e</td>
<td>Alluvial placer Sn</td>
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</table>
AP ALASKAN PENINSULA
AI ALEUTIAN ISLANDS
BS BERING SEA
BB BRISTOL BAY
CS COOK INLET-SUSITNA RIVER
   An Anchorage
   Rd Redoubt
   Vi Valdez Creek
   Wl Willow Creek
   Yn Yentna
CR COPPER RIVER
   Cc Chistochina
   Nc Nelchina
   Nz Nizina
   Pw Prince William Sound
   Yt Yakataga
KP KENAI PENINSULA
   Hp Hope
   Hm Homer
   Sw Seward
KD KODIAK
KR KUSKOKWIM RIVER
   Ak Aniak
   Bt Bethel
   Gb Goodnews Bay
   Mg McGrath
NA NORTHERN ALASKA
   Ba Barrow
   Cn Canning
   Cv Colville
   Ls Lisburne
   Ww Wainwright
NW NORTHWESTERN ALASKA
   Ki Kiana
   Nt Noatak
   Sl Selawik
   Sh Shungnak
SP SEWARD PENINSULA
  Co  Council
  Fh  Fairhaven
  Kg  Kougarok
  Ky  Koyuk
  Nm  Nome
  Pc  Port Clarence
  Sr  Serpentine

SE SOUTHEAST ALASKA
  Ad  Admiralty
  Ch  Chichagof
  Hy  Hyder
  Ju  Juneau
  Kt  Ketchikan
  Kp  Kupreanof
  Pb  Petersburg
  Yk  Yakutat

YR YUKON RIVER
  Av  Anvik
  B1  Black
  Bf  Bonnifield
  Ch  Chandalar
  Cs  Chisana
  Ci  Circle
  Dr  Delta River
  Ea  Eagle
  Fb  Fairbanks
  Fm  Fortymile
  Gp  Goodpaster
  Hs  Hot Springs
  Hu  Hughes
  Id  Iditarod
  In  Innoko
  Ka  Kaiyu
  Kn  Kankishna
  Kk  Koyukuk
  Ma  Marshall
  Ml  Melozitna
  Rm  Rampart
  Ru  Ruby
  Sj  Sheenjek
  Tk  Tok
  Tv  Tolovana
  Yf  Yukon Flats
Tectonostratigraphic terranes (TST)

Alaska (from Jones and others, 1984; Monger and Berg, 1984)

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<td>Coldfoot subterrane of the Arctic Alaska terrane</td>
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<tr>
<td>AAD</td>
<td>DeLong Mountains subterrane of the Arctic Alaska terrane</td>
</tr>
<tr>
<td>AAE</td>
<td>Endicott Mountains subterrane of the Arctic Alaska terrane</td>
</tr>
<tr>
<td>AAH</td>
<td>Hammond subterrane of the Arctic Alaska terrane</td>
</tr>
<tr>
<td>AAN</td>
<td>North Slope subterrane of the Arctic Alaska terrane</td>
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<tr>
<td>AM</td>
<td>Amgayucham terrane</td>
</tr>
<tr>
<td>AX</td>
<td>Alexander terrane</td>
</tr>
<tr>
<td>AXA</td>
<td>Admirality subterrane of the Alexander terrane</td>
</tr>
<tr>
<td>AXC</td>
<td>Craig subterrane of the Alexander terrane</td>
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<tr>
<td>AXN</td>
<td>Annette subterrane of the Alexander terrane</td>
</tr>
<tr>
<td>BP</td>
<td>Broad Pass terrane</td>
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<tr>
<td>BR</td>
<td>Bridge River terrane</td>
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<td>BRY</td>
<td>Baldry terrane</td>
</tr>
<tr>
<td>BV</td>
<td>Barkerville terrane</td>
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<tr>
<td>CC</td>
<td>Cache Creek terrane</td>
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<tr>
<td>CCB</td>
<td>Bonaparte subterrane of the Cache Creek terrane</td>
</tr>
<tr>
<td>CCF</td>
<td>French Range subterrane of the Cache Creek terrane</td>
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<td>CCM</td>
<td>Marble Range subterrane of the Cache Creek terrane</td>
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<tr>
<td>CCN</td>
<td>Nakina subterrane of the Cache Creek terrane</td>
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<tr>
<td>CCP</td>
<td>Pavilion subterrane of the Cache Creek terrane</td>
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<tr>
<td>CCS</td>
<td>Sentinel subterrane of the Cache Creek terrane</td>
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<td>Chugach terrane</td>
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<td>Chulitna terrane</td>
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<td>Chilliwack terrane</td>
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<tr>
<td>CR</td>
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<tr>
<td>CW</td>
<td>Clearwater terrane</td>
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<tr>
<td>CZ</td>
<td>Crazy Mountains terrane</td>
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<tr>
<td>DL</td>
<td>Dillinger terrane</td>
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<tr>
<td>HZ</td>
<td>Hozameen terrane</td>
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<tr>
<td>GD</td>
<td>Goodnews terrane</td>
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<tr>
<td>IN</td>
<td>Innoko terrane</td>
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<tr>
<td>KA</td>
<td>Kandik River terrane</td>
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<tr>
<td>KG</td>
<td>Kagvik terrane</td>
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<tr>
<td>KH</td>
<td>Kahiltna terrane</td>
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<td>Kachimak terrane</td>
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<tr>
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<td>Kluane terrane</td>
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<tr>
<td>KD</td>
<td>Kootenay terrane</td>
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<tr>
<td>KY</td>
<td>Koyukuk terrane</td>
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<tr>
<td>LG</td>
<td>Livengood terrane</td>
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<tr>
<td>MAN</td>
<td>Manley terrane</td>
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<tr>
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<td>McLeod terrane</td>
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<td>Minchumina terrane</td>
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<td>MNK</td>
<td>Minook terrane</td>
</tr>
<tr>
<td>MT</td>
<td>Methow-Tyaughton terrane</td>
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</table>
MY Mystic terrane
NK Nooksack terrane
NN Nenana terrane
NX Nixon terrane
NY Nyack terrane
PC Porcupine terrane
PE Peninsular terrane
PN Pingston terrane
PW Prince William terrane
QN Quesnellia terrane
QNR Harper River subterrane of the Quesnellia terrane
QNO Okanagan subterrane of the Quesnellia terrane
RB Ruby terrane
SD Seward terrane
SE Saint Elias terrane
SH Shuksan terrane
SHE Sheenjek terrane
SK Skagit terrane
SM Slide Mountain terrane
ST Stikinia terrane
SU Sustina terrane
SV Seventymile terrane
TA Tracy Arm terrane
TG Togiak terrane
TK Tikchik terrane
TU Taku terrane
TZ Tozitna terrane
VEN Venetie terrane
WC Woodchopper Canyon terrane
WF West Fork terrane
WHM White Mountains terrane
WM Windy-McKinley terrane
WR Wrangellia terrane
WS Wickersham terrane
WY Windy terrane
YA Yakutat terrane
YO York terrane
YT Yukon Tanana terrane

Geologic symbols used to designate geologic ages of units or rock assemblages that are not accreted
Cz Rocks of Cenozoic age
K Rocks of late Cretaceous age
T Rocks of Tertiary age
GN Gravina-Nutzotin Belt
Abbreviations used for ages of the geologic time scale

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Period</th>
<th>Age</th>
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<td>Cz</td>
<td>Cenozoic (Tertiary)</td>
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<tr>
<td>Tq</td>
<td>Quaternary</td>
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<td>Tp</td>
<td>Pliocene</td>
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<td>Tm</td>
<td>Miocene</td>
<td>23.7 Ma</td>
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<td>To</td>
<td>Oligocene</td>
<td>36.6 Ma</td>
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<tr>
<td>Te</td>
<td>Eocene</td>
<td>57.8 Ma</td>
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<tr>
<td>Ta</td>
<td>Paleocene</td>
<td>66.4 Ma</td>
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<tr>
<td>Mz</td>
<td>Mesozoic</td>
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<td>Cretaceous</td>
<td>144 Ma</td>
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<tr>
<td>J</td>
<td>Jurassic</td>
<td>208 Ma</td>
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<td>Tr</td>
<td>Triassic</td>
<td>245 Ma</td>
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<tr>
<td>Pz</td>
<td>Paleozoic</td>
<td>245-570 Ma</td>
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<tr>
<td>P</td>
<td>Permian</td>
<td>266 Ma</td>
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<tr>
<td>IP</td>
<td>Pennsylvanian</td>
<td>320 Ma</td>
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<tr>
<td>M</td>
<td>Mississippian</td>
<td>360 Ma</td>
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<tr>
<td>D</td>
<td>Devonian</td>
<td>408 Ma</td>
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<td>Silurian</td>
<td>438 Ma</td>
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<td>O</td>
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<td>505 Ma</td>
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<tr>
<td>C</td>
<td>Cambrian</td>
<td>570 Ma</td>
</tr>
<tr>
<td>Pc</td>
<td>Precambrian</td>
<td>&gt;570 Ma</td>
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The time-stratigraphic terms, early (e), middle (m), and late (l), have been applied as modifiers to the age designations where the fossil data are sufficiently restrictive. Radiometric ages are used where available and are expressed in million years (Ma).

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   772116 Eagle River, AK 99577

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APPENDIX II

SAMPLE INFORMATION SHEET FOR COMMON-Pb ISOTOPIC ANALYSIS

<table>
<thead>
<tr>
<th>Contributor: _____________________</th>
<th>Sent to: S. E. Church</th>
</tr>
</thead>
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<tr>
<td>address: ________________________</td>
<td>Branch of Geochemistry</td>
</tr>
<tr>
<td></td>
<td>U. S. Geological Survey</td>
</tr>
<tr>
<td></td>
<td>P. O. Box 25046, MS 973</td>
</tr>
<tr>
<td></td>
<td>Denver, CO 80225</td>
</tr>
<tr>
<td>phone: _________________________</td>
<td>(303) 236-1900</td>
</tr>
<tr>
<td>date: _________________________</td>
<td>FTS 776-1900</td>
</tr>
</tbody>
</table>

SAMPLE No. ____________________ Lab. No. ____________________

Sample Location: Lat.___________ Long.______________
or sec. ______ Township _______ & Range _________
Quadrangle _______________ State ________________
Name of deposit or occurrence ____________________
USBM Region ___________ District _____________

GEOLOGIC INFORMATION

Sample Source___________ Type of host-rock____________
Age of host-rock (how obtained?) _______________________
Formation ___________________________________________
Tectonostratigraphic terrane (if appropriate) ____________
Descriptive information (structure, texture, form, etc.) __________
Mineralogy of sample ________________________________
Mineralogy of deposit ________________________________
Gangue minerals ______________________________________
Structural and Stratigraphic relations ____________________

Deposit type (Singer and Cox, 1986) _____________________
Age of Mineralization (how obtained?) _____________________
Size of deposit ________________________________

Other field information:

Chemical data available: Chemical analysis ( ) Modal analysis ( )
Thin or polished sections ( ) Spectrographic analysis ( )
Stable isotopic data ( ) Other (specify)________________

Are detailed studies of this deposit or occurrence published or in progress? ________________________________

References:

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