This Repository is a written summary of structural data from gold mines, prospects and mineral occurrences in the accretionary complex of southern and southeastern Alaska. The descriptions of the various areas in the text are abstracted from the written descriptions below, and here they are discussed from west to east. Most data is plotted on the stereonets in Figure 3 of the paper. In addition, the raw data for each area is also included, and these data are plotted as strike and dip using the convention that strike is listed as an azimuth from 0° to 360° and the dip is to the right when looking toward the strike azimuth. For linear data, the trend is listed first as an azimuth from 0° to 360°, then the plunge. For location of the areas, refer to Figure 1 in the text. The term "barren" in the structural data table headers means the faults have quartz but no known gold. The term "generic" faults refers to structures that are known to be faults, but without a known sense of offset. A question mark after the fault type indicates weak evidence supported the interpretation of fault slip.

## Kodiak Area

*Area*—Includes all gold-quartz prospects on Kodiak and adjacent Islands. None of these prospects was particularly large.

*Data Sources*—All data are from the compilation of structural data at gold mineral occurrences by Haeussler and Bradley (1993), and the most recent data is 1937 vintage.

*Geologic Setting*—All the known prospects are either in the Kodiak Formation or in diorite or granodiorite intrusions that cut the Kodiak Formation, with the exception of one prospect that cuts the Uyak Complex (McHugh Complex equivalent). One of the intrusions appears to be related to the much larger, northeast striking, Kodiak batholith. Four of the twelve prospects on which we have data are near an intrusion, three are in structures that cut an intrusion, and one is at the contact of an intrusion.

*Structural Characteristics*—Bedding and cleavage strike northeast, as is expected from regional geologic mapping (Moore, 1969), but bedding generally dips to the southeast. The dikes strike northeast and dip steeply, subparallel to the elongate Kodiak batholith. There are two main orientations of gold-quartz veins: northeast striking and northwest striking. The northwest-striking veins are approximately perpendicular to cleavage, the northeast-striking veins are roughly parallel to cleavage. At least two of the gold-quartz veins (one northeast striking, the other an east-striking strike-slip fault) are demonstrably in a fault zone. Two generic faults are at a 60° angle to bedding and are steeply dipping. Thus, the late-fault orientations are not controlled by a pre-existing fabric.

*Cross-Cutting Structural Relationships and Age Constraints*—The gold mineral occurrences are in the Kodiak Formation, the Uyak Complex, or in diorite or granodiorite intrusions that cut the Kodiak Formation. Because three of the prospects are in structures that cut intrusions, at least some of the gold-quartz veins are younger than the intrusions. One probable west- or northwest-striking fault cuts a north-striking dike and a northeast-striking quartz vein.

| bedding | cleavage | dikes | generic faults - mineralized | strike-slip faults | mineralized quartz veins |
|---|---|---|---|---|---|
| 050 25 | 034 90 | 045 80 | 083 60 | 250 73 | 050 25 |
| 055 40 | 219 75 | 040 85 | 285 90 | | 055 40 |
| 60 60 | | 043 85 | | | 060 40 |
| 55 60 | | | | | 055 60 |
| 163 78 | | | | | 043 40 |
| 198 55 | | | | | 041 40 |
| | | | | | 038 50 |
| | | | | | 041 50 |
| | | | | | 045 50 |
| | | | | | 149 60 |
| | | | | | 155 40 |
| | | | | | 250 80 |
| | | | | | 125 65 |
| | | | | | 250 73 |
| | | | | | 245 71 |
| | | | | | 105 85 |
| | | | | | 183 78 |
| | | | | | 120 75 |

## Seldovia Quadrangle

*Area*—Includes the six gold mines and prospects in the USGS Seldovia 1:250,000-scale quadrangle excluding the Nuka Bay area, which is discussed in the following section. Four are near the southern extent of the Kenai peninsula, one is near Kachemak Bay—due east of Homer, and one is in Thunder Bay.

*Data Sources*—The data is from the compilation by Haeussler and Bradley (1993) and from our visits to the Port Dick prospect and a gold occurrence in Thunder Bay.

*Geologic Setting*—Five of the seven localities are hosted by rocks of the McHugh Complex. The Thunder Bay gold occurrence is a polymetallic gold-sulfide vein that cuts a granitic intrusion in the Valdez Group. One other mineral occurrence is near Thunder Bay in the Valdez Group. The Nuka Bay area, discussed in the following section, is also entirely within the Valdez Group, although some of the veins are within granitic dikes. There are numerous dikes in the Seldovia quadrangle that generally have a northwesterly strike, and large, sill-like intrusions in the eastern part of the quadrangle have a north-northeasterly strike.

*Structural Characteristics*—The data show that bedding, cleavage, bedding and cleavage intersection lineations, and fold axes strike north-northeast—consistent with our regional mapping in the quadrangle. The mineralized fault, and the mineralized quartz veins typically have orientations perpendicular to regional structural trends. A couple of the gold-quartz vein orientations are from the occurrence in the dike at the head of Port Dick. The dikes in the quadrangle tend to be perpendicular to structure and strike northwest (see Nuka Bay data). Five of the seven gold mineral occurrences are within or near dikes. The dextral-normal or normal-dextral faults are from east-west striking faults that are mineralized and cut the dike in Thunder Bay. Four of the seven gold mineral occurrences lie within fault zones.

*Cross-Cutting Relationships and Age Constrains*—The gold-quartz veins and faults cut the McHugh Complex, the Valdez Group, and the granitic intrusions. The dextral-normal or normal-dextral mineralized faults are also younger than the granitic intrusions. Haeussler et al. (1995) report $^{40}$Ar/$^{39}$Ar ages of mineralization at the Port Dick prospect and the Thunder Bay occurrence of 57.3 ± 0.1 Ma and 52.9 ± 0.1 Ma, respectively.

| generic faults - mineralized | mineralized quartz veins | mineralized dextral-normal faults | mineralized dextral-normal slickensides |
|---|---|---|---|
| 341 60 | 341 60 | 255 88 | 073.8 30.0 |
| | 306 75 | 278 85 | 089.7 58.6 |
| | 306 85 | 095 76 | 101.4 24.2 |
| | 296 75 | | |
| | 116 80 | | |
| | 111 83 | | |
| | 301 80 | | |
| | 207 40 | | |

## Nuka Bay

*Area*—Nuka Bay lies within the USGS Seldovia 1:250,000-scale quadrangle, but because the lands surrounding Nuka Bay have the greatest gold-quartz vein concentration within the quadrangle, the data for this area are considered separately.

*Data Sources*—We have more high-quality structural data on gold-mineral occurrences in the Nuka Bay area than from any other area. The data comes from our examination of all prospects near the shores of the bay, and the compilation of Haeussler and Bradley (1993), which relies heavily on Richter (1970).

*Geologic Setting* —The entire area lies within the Valdez Group, although granitic intrusions of the Sanak-Baranof belt are present and common. In general, these are less than 5-m wide, but are up to approximately 30-m wide. Five of 15 documented mineral occurrences lie within, or at the margins of dikes.

*Structural Characteristics*—Bedding and cleavage both strike north-northeast, but cleavage has a slightly more north-northeasterly trend, suggesting—as would be expected—that it formed at a slightly later time than the tilting of bedding. Dikes are always steeply dipping, with most striking northwest, but dikes along which there are gold prospects strike northeast. In general, whole-rock geochemical analyses on dikes in the Seldovia quadrangle, including those in the Nuka Bay area, indicate less than a 5–8 ppb gold. However, two of the 75 dikes analyzed (one in, and one near Nuka Bay; they lie along strike ~10 km apart) have anomalous gold (> 100 ppb) and strike north-northwest (Bradley, unpublished data). In addition, mafic dikes in the quadrangle generally have east-west strikes, but more felsic dikes (>59 wt. % silica) have east-west, as well as northwest-southeast strikes. Thus, only the felsic dikes have the northwest-southeast strikes, of which two of these dikes have documented anomalous gold. Nonetheless, most of the dikes along which there was production or exploration in the Nuka Bay area strike northeast. Finally, the number of dikes in an area appears to have no correlation with the presence or absence of gold mineralization. For example, there are more dikes on the south side of the mouth of Quartz Bay than anywhere else in the Nuka Bay area, but there are no geochemical stream sediment anomalies there.

Most gold-bearing quartz veins are within left-lateral faults that strike east-west. There was strike-slip faulting on some additional faults with the same orientation, and thus we infer these are probably also sinistral-slip faults. There were also gold-quartz mineralized normal faults, but there are no mineralized thrust faults. At least 8 of the 15 gold-quartz mineral occurrences in the Nuka Bay area are along faults. The mineralized veins and faults are steeply dipping, up to 1.5 m wide, have up to 10% wall-rock fragments, and cut bedding and cleavage at a high angle. Some veins are ribboned with multiple, parallel veins that are 1–2 cm thick, with euhedral quartz that appears to have been growing into void space. Up to 23 such ribbons were counted across one prospect, implying multiple episodes of fluid injection. The orientation of the veins does not appear to be influenced by the orientation of bedding or cleavage. There are also barren veins with the same east-west orientation, indicating some pulses of fluid flow were Au-rich, and others were Au-poor. There are also some gold-quartz veins along right-lateral faults that strike northeast. The dextral and sinistral faults appear to form a conjugate fault set, and they are texturally the same. Thus it can be argued that both sets of faults are of the same generation. The bisector of the conjugate fault sets strikes northeast and indicates compression parallel to the regional strike of bedding during brittle faulting. The bisector also has the same orientation as the strike of dikes along which there is some gold mineralization. This relationship suggests that the dikes were intruded into the same stress regime that resulted in the development of the strike slip faults.

In addition to the gold-bearing quartz veins, there are some thin (<1 cm thick) quartz veins associated with thrust faults. These thrust faults, seen in only a few locations, have strikes parallel to bedding, and presumably are related to thrust faulting or underplating earlier in the accretionary history. These are the oldest generation of quartz veins observed. There are also barren quartz veins oriented perpendicular to thick sandstone beds that generally strike northwest-southeast. These veins are steeply dipping and have quartz mineral fibers that indicate orogen-parallel extension. There is no faulting along these veins, and thus they record only a small amount of extension. These fibrous quartz veins predate the gold-bearing quartz veins because they are hornfelsed by intrusions of the Sanak-Baranof belt in the McCarty Fiord area. Therefore, in the Nuka Bay area there was orogen-parallel extension before emplacement of ridge subduction related intrusions, and orogen-parallel contraction afterward—during gold mineralization and dike intrusion.

Post gold-quartz vein deposition, there is evidence for sinistral, dextral, and normal brittle faulting, as indicated by brittle faults within the gold-quartz veins that offset sequences of ribboned quartz veins or by brittle faults that have wall rock fragments along them. In fact, in all cases where gold-quartz veining occurred along a fault (which is at virtually all mineral occurrences), there are no quartz veins that can be shown to cross the entire width of the fault zone. Therefore, there is at least some brittle faulting post-mineralization at all locations.

In addition, many of the strike-slip faults that host gold-bearing quartz veins also have muddy gouge zones at their margins. These gouge zones, typically less than 30 cm wide, consist of brecciated and altered wall rock fragments. Some gouge zones also contain a few narrow quartz veins. It is uncertain whether these gouge zones represent movement on the faults soon after cessation of hydrothermal activity and are coeval with the faulting described in the previous paragraph (which we consider most likely), or whether they represent reactivation of the older faults at a substantially younger time.

The youngest phase of brittle faulting in the Nuka Bay area consists of faults that are filled with recessive-weathering muddy gouge zones up to 10 m wide, and have no quartz veins within them. These faults form prominent lineaments on aerial photographs that cut across all structures. In our examination of several of these lineaments in shoreline exposures, there was no indication of significant offset on these faults.

*Cross-Cutting Relationships and Age Constrains*—The gold-quartz veins all cut the Valdez Group or intrusions of the Sanak-Baranof belt that cut the Valdez Group. Reliable dates on Sanak-Baranof belt intrusions within the Seldovia quadrangle range between 53.7 and 57 Ma (Bradley et al., 1993; Haeussler et al., 1995). Haeussler et al. (1995) report two $^{40}$Ar/$^{39}$Ar dates of 55.6 ± 0.1 Ma and 55.9 ± 0.1 Ma on sericite from gold-quartz vein tailings taken from the Beauty Bay mine. These dates indicate that gold mineralization occurred close to the time of Sanak-Baranof belt magmatism.

We also found the following cross cutting relationships. At the Charles Frank prospect—after mineralization there was faulting along a sinistral fault that strikes ~230°. Along a barren quartz-mineralized fault zone there was early sinistral-normal faulting followed by dextral-normal faulting on a structure striking 270°. At one locality we found stretched clasts, indicating subhorizontal constrictional strains, in a pebbly mudstone subparallel to the quartz fibers, which are pre-intrusion-of-plutons. However, gold-quartz mineralization is on a normal fault at the locality. This indicates that the strain regime changed significantly between imposing the orogen parallel constrictional strains and the normal-brittle faulting and gold mineralization. At one locality there were an en-echelon set of sigmoidal-shaped veins that were cut by some of the northwest-striking veins with mineral fibers. The sense of motion on the sigmoidal-shaped veins was consistent with thrusting near the subduction zone. The sigmoidal veins are probably metamorphic-secretion veins that formed during metamorphism and ductile deformation prior to gold mineralization (see also Goldfarb et al., 1986). At another locality, there was a dextral fault striking 220° with quartz veining and wall rock fragments in it that cuts some quartz veins. This locality is near where there was gold-quartz deposition along a sinistral fault striking 078°, indicating that at least some dextral faulting postdates some quartz veining, but perhaps also postdates sinistral faulting and gold-quartz mineralization. At a different locality there are two strike-slip faults, both possibly sinistral faults, one with gold-quartz mineralization oriented 090/70 and another with quartz oriented 236/90. These two faults are cut by a probable thrust fault oriented 068/80. Therefore, this thrust may post-date gold mineralization, and is the only probable thrust we are aware of that post-dates gold-quartz veining.

| bedding | cleavage | barren quartz veins with fibers | quartz fibers in barren veins | mineralized quartz veins | barren quartz veins |
|---|---|---|---|---|---|
| 231 27 | 199 58 | 142 72 | 205 7 | 114 71 | 132 74 |
| 285 20 | 195 70 | 135 90 | 221 6 | 102 87 | 271 52 |
| 258 35 | 200 72 | 127 84 | 186 12 | 106 75 | 272 49 |
| 350 25 | 217 54 | 315 89 | 203 6 | 136 71 | 136 71 |
| 211 51 | 207 62 | 140 79 | 252 33 | 283 83 | 252 57 |
| 218 24 | 203 59 | 319 86 | 233 11 | 235 77 | 137 74 |
| 220 80 | 046 85 | 307 81 | 035 12 | 250 68 | 112 68 |
| 225 30 | 206 26 | 322 83 | 198 10 | 255 62 | 138 70 |
| 171 52 | 181 49 | 129 90 | 9 11 | 220 65 | 134 74 |
| 200 75 | 179 61 | 305 81 | 8 15 | 143 68 | 125 65 |
| 220 55 | 340 82 | 148 84 | 17 13 | 320 60 | 124 86 |
| 194 35 | 170 86 | 150 85 | 205 4 | 351 76 | 124 74 |
| 202 61 | 201 57 | 149 84 | 250 30 | 132 82 | 168 55 |
| 219 64 | 175 60 | 292 81 | 204 5 | 119 85 | 223 55 |
| 223 73 | 198 72 | 127 67 | 22 20 | 110 83 | 59 81 |
| 230 44 | 220 70 | 344 84 | 213 17 | 240 86 | 246 86 |
| 015 80 | 202 74 | 126 80 | 019 16 | 285 84 | 120 85 |
| 196 46 | 201 80 | 333 81 | 220 10 | 272 85 | 160 88 |
| 191 26 | 350 90 | 348 88 | 065 05 | 078 87 | 35 86 |
| 216 45 | 195 73 | 285 84 | 224 19 | 082 68 | 105 84 |
| 228 49 | 143 84 | 102 81 | 210 10 | 079 44 | 280 80 |
| 42 65 | 188 70 | 273 71 | 5 6 | 070 52 | 95 57 |
| 226 70 | 169 77 | 282 79 | 177 7 | 085 71 | 110 73 |
| 55 53 | 201 57 | 285 77 | 196 17 | 097 80 | 350 75 |
| 208 42 | 11 83 | 286 81 | 19 16 | 061 80 | 70 80 |
| 222 56 | 199 60 | 256 80 | 2 4 | 056 83 | 100 86.5 |
| 200 20 | 199 70 | 139 72 | 305 15 | 331 62 | 325 70 |
| 200 43 | 195 85 | 160 88 | 210 22 | 275 90 | 25 76 |
| 22 36 | 197 86 | 355 85 | 255 7 | 145 65 | 19 86 |
| 204 31 | 192 72 | 181 83 | 241 11 | 080 72 | 25 81 |
| 160 75 | 220 69 | 336 79 | 240 3 | 092 70 | 26 75 |
| 236 46 | 191 48 | 165 90 | 35 24 | 142 63 | 185 89 |
| 210 56 | 181 76 | 135 87 | 225 8 | 085 70 | |
| 200 30 | 182 72 | 147 85 | 34 10 | 087 76 | |
| 150 67 | 25 79 | 158 68 | 351 30 | 043 69 | |
| 050 26 | 191 40 | 88 56 | 220 9 | 072 73 | |
| | 355 90 | 260 90 | 49 12 | 106 85 | |
| | 010 90 | 260 89 | 205 3 | 136 90 | |
| | 000 90 | 66 72 | 42 5 | 080 70 | |
| | 036 90 | 310 88 | 8 4 | 190 65 | |

(continued)

(continued)

| bedding | cleavage | barren quartz veins with fibers | quartz fibers in barren veins | mineralized quartz veins | barren quartz veins |
|---|---|---|---|---|---|
| | 190 50 | 78 82 | 45 11 | 075 90 | |
| | 210 60 | 110 78 | 292 27 | 045 60 | |
| | 188 50 | 95 82 | 050 34 | 253 67 | |
| | 205 35 | 175 85 | 90 0 | 132 85 | |
| | | 185 72 | 75 4 | 272 62 | |
| | | 326 46 | 263 36 | 280 60 | |
| | | 170 52 | 031 14 | 242 74 | |
| | | 350 51 | 067 12 | 285 80 | |
| | | 134 71 | 204 4 | 260 65 | |
| | | 155 71 | 194 4 | 194 75 | |
| | | 125 77 | 010 11 | 215 50 | |
| | | 141 78 | 201 4 | 251 56 | |
| | | 127 77 | 021 03 | 277 80 | |
| | | 124 80 | 158 7 | 267 80 | |
| | | 135 83 | 327 19 | 270 82 | |
| | | 46 68 | 351 30 | 283 80 | |
| | | 034 78 | 190 4 | 266 84 | |
| | | 081 73 | 185 3 | 269 70 | |
| | | 114 79 | 248 5 | 242 70 | |
| | | 116 82 | 198 12 | 080 90 | |
| | | 157 80 | 213 11 | 077 86 | |
| | | 124 86 | 193 19 | 280 90 | |
| | | 144 84 | 221 12 | 095 76 | |
| | | 092 90 | 65 17 | 275 82 | |
| | | 141 87 | 44 10 | 150 67 | |
| | | 140 86 | | 090 80 | |
| | | 143 88 | | 122 80 | |
| | | | | 232 79 | |
| | | | | 070 90 | |
| | | | | 280 70 | |
| | | | | 105 85 | |

| mélange fabric | stretched clasts- lineation | dikes- with no associated mineralization | dikes- with associated mineralization | generic faults - mineralized |
|---|---|---|---|---|
| 191 66 | 26 8 | 156 76 | 273 84 | 80.0 90.0 |
| 188 70 | 30 2 | 147 81 | 300 84 | 280.0 60.0 |
| 189 71 | | 235 74 | 115 65 | 234.0 63.0 |
| 187 82 | | 245 85 | 034 67 | 242.0 70.0 |
| 200 77 | | 155 75 | 049 83 | 275.0 82.0 |
| 187 77 | | 153 66 | 043 69 | |
| 196 46 | | 205 65 | 072 73 | |
| 187 57 | | 140 70 | 072 85 | |
| | | 000 75 | 084 70 | |
| | | 087 83 | | |
| | | 150 75 | | |
| | | 085 87 | | |

| mineralized dextral faults | mineralized dextral faults - slickensides | dextral faults- barren | dextral(?) faults- barren | dextral faults- barren- slickensides |
|---|---|---|---|---|
| 220 50 | 246.7 28.1 | 125 64 | 214 81 | 140.3 28.4 |
| 229 42 | 043.8 4.7 | 070 83 | 245 22.8 | 249.4 5.0 |
| | | 220 72 | | 36.2 11.4 |
| | | 190 67 | | 001.9 18.4 |
| | | 008 84 | | 009.1 9.9 |
| | | 201 79 | | 22.9 9.8 |
| | | 200 77 | | 18.0 8.8 |
| | | 87 88 | | 087.8 22.0 |
| | | 105 85 | | |

| sinistral faults- barren | sinistral faults- barren- slickensides | sinistral(?) faults- barren | sinistral(?) faults- barren- slickensides | sinistral faults- mineralized | sinistral faults- mineralized- slickensides |
|---|---|---|---|---|---|
| 246 86 | 064.8 17.0 | 208 63 | 212.7 34.1 | 230 70 | 97.9 9.8 |
| 170 85 | | 041 78 | | 250 68 | 079.1 20 |
| | | | | 350 89 | 257.4 12 |
| | | | | 280 78 | 92.8 7.5 |
| | | | | 078 87 | 236 2 |

| sinistral(?) faults-mineralized | sinistral(?) faults-mineralized-slickensides | strike-slip faults-mineralized | strike-slip faults-mineralized-slickensides | strike-slip fault-barren |
|---|---|---|---|---|
| 283 83 | 0 82 | 272 85 | 272.6 7.0 | 9 83 |
| 090 70 | 216.4 29.0 | 080 90 | 076 35 | |
| 236 90 | | 280 60 | 92.1 19.8 | |
| 082 68 | | 275 82 | | |
| 55 60 | | | | |

| dip-slip faults-mineralized | dip-slip fault slickensides-mineralized | dip-slip faults-barren | dip-slip fault slickensides-barren | normal faults-barren | normal faults-barren- slicks |
|---|---|---|---|---|---|
| 270 48 | 335.4 45.3 | 271 52 | 006 32 | 251 36 | 188.1 42.4 |
| 345 34 | 087.0 33.4 | 272 49 | 012 35 | 270 61 | 182.0 49.9 |
| | | 230 46 | | 68 83 | |
| | | 230 41 | | 160 45 | |
| | | 319 41 | | 11 85 | |

| normal faults-mineralized | normal faults-mineralized-slickensides | normal(?) fault-barren | normal(?) fault-barren-slickensides |
|---|---|---|---|
| 351 76 | 002 34 | 319 41 | 12 35 |
| 079 44 | 36.9 55.3 | | |
| 070 52 | 314.8 51.8 | | |
| | 220.2 75.3 | | |
| | 213.1 38.6 | | |
| | 101 85 | | |

## Seward-Moose Pass

*Area*—This is a linear region, between Seward and Moose Pass.

*Data Sources*—All the plotted data are from the compilation of Haeussler and Bradley (1993). Most data is 1915 vintage, but some is from a Bureau of Mines assessment in 1984 (Hoekzema et al., 1987).

*Geologic Setting*—All the lode-gold mineral occurrences in this area lie within the Valdez Group. There are a few dikes related to the Sanak-Baranof magmatic belt within the region; two of the 20 mineral occurrences are near an intrusion, and these both cut dikes.

*Structural Characteristics*—Bedding and cleavage in this area both strike north-south and dip steeply toward the east. Regional trends of bedding and cleavage tend to be somewhat more north-northeasterly, than this data set. Only one dike orientation was recorded and it strikes northeast-southwest, and is vertically dipping—like in the Moose Pass-Hope area (described in the following section). Mineralized gold-quartz veins all dip steeply to the east, but their strike varies almost 180° from west-northwest to west-southwest. There is a slight majority of veins that strike northeast-southwest. In addition, two of the three more significant mines in the area (East Point and Falls Creek mines) have veins that strike northeast, but another mine (Skeen-Lechner) exploited a vein that strikes northwest (~337°). The variability in the orientation of the gold-quartz veins shows that regional structural trends in the bedrock did not influence the orientation of the structures that were mineralized. Nine of the 20 mineral occurrences are demonstrably along faults. This is notable considering the antiquity of most of the observational data. It seems likely that most mineralized veins in this area lie along faults. Hoekzema and others (1987) report that there is 1 to 4 inches of gouge on both sides of the main vein of the Skeen-Lechner mine. This indicates there was continued movement on the fault after mineralization. Most of the mineralized faults strike northeast or north-northeast, but the sense of offset could not be determined from the recorded data. Based on similarities to mineralized faults in the Moose Pass-Hope area, discussed in the following section, it appears likely that these north-northeast- or northeast-striking gold-quartz mineralized faults have dextral offset.

*Cross-Cutting Relationships and Age Constrains*—As discussed above, all the gold-mineral occurrences lie within rocks of the Valdez Group or intrusions of the Sanak-Baranof magmatic belt, and thus must be younger than both. In addition, there are distinctive northeast-striking, gouge-filled (not gold-quartz mineralized) dextral faults that cut the gold-quartz veins and faults. For example, at the Skeen-Lechner mine, the main north-northwest striking vein is dextrally offset 13 m along a vertical fault striking 056° (Johnson, 1915). “The sheared zone along the fault plane is 12 to 23-inches wide and is filled with crushed country rock containing fragments of vein quartz” (Johnson, 1915, p. 156).

| bedding | cleavage | dikes | generic faults - mineralized | dextral faults-barren | mineralized quartz veins |
|---|---|---|---|---|---|
| 18 90 | 15 90 | 033 90 | 2 90 | 54 89 | 305 81 |
| 343 90 | 18 90 | | 18 90 | 64 89 | 303 85 |
| 7 75 | 7 55 | | 286 90 | 69 65 | 285 85 |
| 186 85 | 7 80 | | 6 90 | 56 89 | 15 90 |
| 352 70 | 5 50 | | 23 80 | 57 89 | 232 90 |
| 352 35 | 9 48 | | 301 55 | | 2 90 |
| 3 30 | | | 51 90 | | 18 90 |
| | | | 51 75 | | 286 90 |
| | | | 65 90 | | 6 90 |
| | | | | | 30 90 |
| | | | | | 23 80 |
| | | | | | 290 90 |
| | | | | | 12 45 |
| | | | | | 105 80 |
| | | | | | 301 55 |
| | | | | | 55 45 |
| | | | | | 55 60 |
| | | | | | 27 40 |
| | | | | | 51 90 |
| | | | | | 51 75 |
| | | | | | 65 90 |
| | | | | | 345 45 |
| | | | | | 315 65 |
| | | | | | 338 45 |
| | | | | | 339 45 |
| | | | | | 337 60 |
| | | | | | 337 70 |
| | | | | | 338 60 |
| | | | | | 339 48 |
| | | | | | 344 40 |
| | | | | | 337 60 |
| | | | | | 70 65 |
| | | | | | 70 90 |

## Moose Pass-Hope

*Area*—This area includes the linear belt of gold mineral occurrences between the northwestern end of Kenai Lake and Turnagain Arm. There are a few occurrences that lie to the east of the main trend (see Haeussler and Bradley, 1993).

*Data Sources*—Data from this area comes from the compilation of Haeussler and Bradley (1993), which uses the thesis of Mitchell (1979), Bureau of Mines assessment work (Hoekzema and others, 1987), and Tuck (1933). In addition, we examined and collected structural data from the Oracle, Gilpatrick, Gilpatrick Dike, Nearhouse, Hirshey, and Swetman mines. There is a significant amount of structural data not incorporated into our database on stereonets within Mitchell's (1979) thesis. We discuss his data separately, when it influences the discussion.

*Geologic Setting*—This area lies entirely within the Valdez Group, and felsic dikes of the Sanak-Baranof belt are common. The most significant intrusion is the so-called Gilpatrick dike. This dike has always been referred to in the literature as a single entity, but our field observations near the Oracle and Gilpatrick mines indicate the dike is actually a series of dikes that lie along a linear trend. The map of the Gilpatrick and associated mineralized dikes by Hoekzema et al. (1987, p. 38) indicates there are two main intrusive features in this area. Each feature is discontinuous, but both trend north-northeast (015°). The southern feature is the Gilpatrick series of dikes that are about 18 km long, and vary in width from 0.3 to 4 m, but is typically 1.3 to 1.6 m wide (Tuck, 1933). The northern feature is the Palmer Creek dike that is about 12 km long, with an average thickness of 1 m, but it is locally up to 1.6 m wide (Hoekzema et al., 1987). Taken together these dikes appear as an *en echelon* pair suggesting dextral shear during their intrusion. Twenty of 43 gold mineral occurrences with structural data are along one of these intrusions, and 36 of 43 are within 1 km of an intrusion.

*Structural Characteristics*—Bedding and cleavage both strike north-northeast, are steeply dipping, and from our data and compilation there is no preference of an eastward or westward dip. However, stereonets based on a much larger data set (n=922) in Mitchell (1979, p. 42) show more eastward dips of bedding and cleavage. As mentioned above, our data demonstrates that major dikes in this region strike north-northeast and generally dip steeply to the west. Although it appears that the dikes parallel the strike of bedding and cleavage, they actually cut across the regional structural grain. However, our data may not provide a complete picture. A rose diagram of dikes mapped by Mitchell (1979, p. 35) shows dominant northwest strikes. This is partially due to equal weighting of dike orientations regardless of their length, but it does indicate there are abundant dikes with a northwest strike. Nonetheless, the most important dikes with associated gold-quartz mineralization are associated with the Gilpatrick dike and strike north-northeast.

Gold-bearing quartz veins in this area are typically within steeply-dipping faults and joints, and are commonly 0.3 m wide, but up to 1 m wide. There is a wide range in orientations of the gold-quartz veins, although there are perhaps a few more veins with a north-south strike, in addition to a number of veins with a west-northwest–east-southeast strike. Quartz veins without gold also have a similar dispersion in orientation, but there clearly is a dominant orientation of roughly north-south. As previously stated, about half of the mineral occurrences for which we have structural information lie within or along a dike. In all cases, lode-gold mineralization post-dates intrusion of ~015°-striking dikes. Most gold-quartz veins within or near the dikes strike north-northeast. Tuck (1933) and Mitchell (1979) both noted that many of the mineralized gold-quartz veins in this area do not extend beyond the edges of the dikes, but are confined to fracture fillings that terminate and taper at the dike contact. This indicates that the location of the gold-quartz veins is related to brittle deformation of the dikes. We found that the Gilpatrick dike near the Gilpatrick mine locally had a cleavage, which also suggests significant deformation after intrusion. Nonetheless, many of the veins within dikes, as well as those farther away are associated with faults (Mitchell, 1979). For example, 13 of the 43 gold-mineral occurrences are clearly along faults, and in most documented cases these are north-northeast striking dextral faults. All of the generic faults have an orientation consistent with the north-northeast striking dextral faults. However, there are two gold-quartz mineralized generic faults that are east-west striking, and north-dipping. There is no record of sinistral- or reverse-motion mineralized faults. In 8 of the 20 localities along or within a dike that are cut by late faults, 7 of these 8 faults are dextral (the other is unspecified). At the Gilpatrick Mine, which is located along the Gilpatrick dike, Tuck (1933, p. 513) reported that "Along these transverse faults the movement has invariably been the same, so in drifting on the dike and finding it offset, a good general rule is to turn to the right along the fault surface." Therefore, these are right-lateral faults. Tuck (1933, p. 513) also states, "The horizontal component of the movement where actually observed is usually from a few inches to 15 feet". In addition, dip-slip faults also offset the Gilpatrick dike. Tuck (1933, p. 513) states that some faults cutting the dike have dip-slip slickensides. There was faulting along the mineralized structures after quartz deposition, as demonstrated by slickensided surfaces cutting the gold-quartz veins. Tuck (1933) noted that the margins of many of the dikes were faulted and there was a gouge zone about 10 cm thick, between the dike and the wall rock. Mitchell (1979, p. 51) also states that, "...postvein movement was documented along most fault-related veins." In addition, it is clear from the stereonet data and from the cross-cutting relationships observed in mines and prospects, that there are two sets of dextral faults. The gold-quartz mineralized faults have a north-northeast strike, but there is a later set of faults that strike northeast or east-northeast. Some of these faults have gold-quartz veins and others have muddy gouge in the fault zone with little or no quartz, perhaps indicating a long time span that these faults were active. These faults offset an older generation of gold-quartz veins and faults as well as dikes. It is not clear to us why this late dextral faulting did not reactivate the older structures, but rather formed new ones. Nonetheless, it appears that gold mineralization and brittle faulting must have been going on long enough to allow for this change in stress and strain to occur. It is also important to note that gouge is present on both pre- and post-gold-quartz mineralization faults. Therefore, if the type of gouge developed is related to depth of faulting, the conditions were roughly the same before and after faulting and gold-quartz mineralization.

*Cross-Cutting Relationships and Age Constrains*—The gold-quartz veins all cut the Valdez Group or intrusions of the Sanak-Baranof belt that cut the Valdez Group. There are two isotopic ages from this area that provide additional constraints on the age of mineralization. There is a K-Ar whole rock date of 52.7 ± 1.6 Ma on a hydrothermally altered felsic dike that contains gold-quartz veins (Silberman et al., 1981). Silberman et al. (1981) also reported a K-Ar date of 53.2 ± 1.6 Ma on muscovite from a felsic dike with a gold mineralized quartz vein.

We also found the following cross-cutting relationships. At the Hirshey Carlson mine a northeast-striking dextral fault (051/85) with gold-quartz veins cuts several north-northeast (015/90) striking dextral faults with gold-quartz veins. Also there was a west-striking, north-dipping fault (100/56) with apparent sinistral, or possible normal motion with muddy gouge that cuts a gold-quartz vein oriented 220/60. This same gold-quartz vein cuts a fault oriented 150/82 that has muddy gouge. The point is that there are faults with muddy gouge that predate and postdate gold-quartz mineralization. At the Gilpatrick mine, there is a dextral fault (058/60) that cuts the Gilpatrick dike. In addition, there are dextral faults oriented 041/70 and 067/70 that cut a fault oriented 144/85, but the sense of motion on this fault is unknown. At the Summit Claim along the Gilpatrick dike there are several faults (241-252/70-90E) with normal or dextral or dextral-normal motion that cut the dike. At the Teddy Bear mine there is a mineralized dike that strikes 345/64, and there is a dextral fault that offsets the dike (058-066/51-54). There is at least 1.7 m of offset on this fault. At the Downing-Francisco prospect there is a gold-quartz mineralized dextral fault (340-349/75) that cuts gold-quartz mineralized faults striking 310 and

275. Thus, it appears that these younger faults are clockwise of the older faults. This is also true at the Hirshey Carlson mine where a gold-quartz mineralized dextral fault (046/76) cuts older, more northerly gold-quartz mineralized dextral faults (014/65 and 010/60-70). At the Sunshine mine, Tuck (1933, p. 498) reports some small reverse faults oriented 190/15-30. If correct, these are the only mineralized reverse faults that we are aware of in all of southern Alaska. However, Mitchell (1979) noted a number of faults in the same mine with the same orientation that are said to be normal faults. We favor the interpretation of Mitchell (1979) because interpreting brittle fault kinematic data was in its infancy at the time of Tuck's (1933) report, and because Tuck's (1933) interpretation does not fit the bulk of the data. At the Downing-Whistler prospect there are several barren quartz-mineralized northeast-striking dextral faults (51/80, 51/60, 70/75 with 2 to 60 cm of offset) that cut northwest-striking gold-quartz mineralized dextral faults (348/80 and 348/85). At the Kenai Star or French mine there is another example of mineralization associated with faulting near a dike. The dike at the Kenai Star is oriented 190/85-90, and there is faulting subparallel to the margin of the dike (191/85). As gold-quartz veins were deposited along this fault, and because the fault also cuts the veins, there was motion on this fault before and after gold mineralization along the fault. In addition, there is a younger gold-quartz mineralized dextral fault (205/80) that cuts the older fault and veins. Finally, there is a normal fault (045/60) with clay gouge in the fault zone that cuts all the older structures.

| bedding | cleavage | dikes | quartz veins-mineralized | quartz veins-barren |
|---|---|---|---|---|
| 0 0 | 19 60 | 220 35 | 15 55 | 290 49 |
| 15 80 | 4 65 | 15 65 | 15 68 | 265 85 |
| 195 60 | 24 65 | 15 85 | 38 59 | 0 46 |
| 4 52 | 15 80 | 345 33 | 51 85 | 313 35 |
| 20 52 | 195 60 | 345 64 | 15 85 | 110 83 |
| 4 85 | 20 90 | 348 64 | 55 81 | 50 85 |
| 20 85 | 8 36 | 13 80 | 220 60 | 130 53 |
| 356 80 | 8 43 | 190 85 | 195 60 | 0 75 |
| 15 63 | 20 60 | 190 90 | 330 80 | 293 85 |
| 16 62 | 179 45 | 12 89 | 275 80 | 136 87 |
| 190 60 | 0 57 | 12 85 | 298 80 | 135 87 |
| 200 30 | 168 44 | 5 84 | 12 80 | 132 90 |
| 195 55 | 173 67 | 10 84 | 329 64 | 310 70 |
| 191 56 | 177 70 | 0 45 | 49 49 | 309 80 |
| 199 51 | 168 51 | 0 60 | 350 39 | 308 80 |
| 190 64 | 175 36 | 351 87 | 59 51 | 128 85 |
| 196 50 | 20 84 | | 1 76 | 128 85 |
| 197 65 | 20 75 | | 340 75 | 136 87 |
| 198 48 | 30 75 | | 349 75 | 103 90 |
| 191 56 | 18 75 | | 9 67 | 113 90 |
| 175 33 | 29 75 | | 46 76 | 125 90 |
| 40 74 | 42 62 | | 46 64 | 124 90 |
| 29 75 | 161 87 | | 13 64 | 123 80 |
| 190 85 | 308 23 | | 255 74 | 131 55 |
| 190 90 | 188 72 | | 280 78 | 347 75 |
| 10 45 | 200 78 | | 102 76 | 311 75 |
| 10 60 | 210 45 | | 260 70 | 62 75 |
| 195 60 | 210 60 | | 241 84 | 345 75 |
| 25 72 | 15 60 | | 275 85 | 309 75 |
| 190 40 | 35 60 | | 291 59 | 64 75 |
| 190 60 | 35 80 | | 295 85 | 299 75 |
| 30 89 | 150 78 | | 348 80 | 284 75 |
| 200 60 | 188 48 | | 3 80 | 18 76 |
| 30 89 | 181 51 | | 348 85 | 9 64 |

| quartz veins-mineralized (continued) | quartz veins-barren (continued) | quartz veins-barren (continued) | quartz veins-barren (continued) | quartz veins-barren (continued) | quartz veins-barren (continued) |
|---|---|---|---|---|---|
| 205 80 | 16 66 | 4 50 | 195 64 | 192 60 | 280 90 |
| 191 85 | 102 58 | 13 60 | 120 25 | 166 50 | 310 90 |
| 9 76 | 206 83 | 1 67 | 161 58 | 188 50 | 280 60 |
| 289 65 | 207 80 | 8 63 | 132 54 | 201 60 | 29 80 |
| 280 60 | 206 64 | 358 73 | 159 64 | 169 60 | 351 80 |
| 290 90 | 38 78 | 17 80 | 161 47 | 178 52 | 346 80 |
| 255 30 | 35 79 | 14 45 | 146 47 | 182 60 | 3 80 |
| 320 70 | 355 62 | 15 69 | 140 59 | 283 87 | 346 80 |
| 70 89 | 2 40 | 7 57 | 184 52 | 163 37 | 335 80 |
| 194 70 | 15 50 | 3 69 | 209 44 | 168 34 | 325 80 |
| 15 60 | 335 60 | 18 59 | 171 77 | 166 34 | 142 88 |
| 175 60 | 15 50 | 11 48 | 193 57 | 6 88 | 148 76 |
| 60 89 | 29 88 | 6 58 | 185 44 | 128 37 | 160 87 |
| 30 89 | 27 80 | 5 53 | 171 44 | 345 74 | 144 88 |
| 160 85 | 27 70 | 21 55 | 195 45 | 7 90 | |
| 166 76 | 344 52 | 20 49 | 196 58 | 37 67 | |
| 185 80 | 6 69 | 176 62 | 193 30 | 358 74 | |
| 151 64 | 4 63 | 202 60 | 198 57 | 355 81 | |
| 60 80 | 11 60 | 186 69 | 133 34 | 210 51 | |
| 315 40 | 300 60 | 207 88 | 196 60 | 67 87 | |
| 100 80 | 343 67 | 297 84 | 177 60 | 130 90 | |
| 345 74 | 43 75 | 16 85 | 189 46 | 300 90 | |
| 007 89 | 190 86 | 175 22 | 164 43 | 321 65 | |
| 37 67 | 11 74 | 195 51 | 173 45 | 333 60 | |
| 358 74 | 9 66 | 157 35 | 193 45 | 51 60 | |
| 355 81 | 5 50 | 202 49 | 148 35 | 15 65 | |
| 210 51 | 5 67 | 210 47 | 134 84 | 319 80 | |
| 067 87 | 324 84 | 254 77 | 195 51 | 321 88 | |
| 070 70 | 329 73 | 156 84 | 100 80 | 346 90 | |
| 313 35 | 19 87 | 190 90 | 170 76 | 117 80 | |
| 275 65 | 14 38 | 337 80 | 191 40 | 310 60 | |

| generic faults-mineralized | generic faults-mineralized-slickensides | generic faults-barren | generic faults-barren-slickensides | dextral faults-mineralized | dextral faults-mineralized-slickensides |
|---|---|---|---|---|---|
| 15 68 | 111 54 | 351 54 | 91 55 | 15 55 | 21 9 |
| 38 59 | 191 6 | 32 69 | 170 20 | 51 85 | 231 4 |
| 330 58 | | 5 75 | 130 0 | 15 85 | 195 40 |
| 14 65 | | 11 72 | 180 0 | 55 81 | 195 15 |
| 200 60 | | 13 55 | | 220 60 | 55 5 |
| 200 84 | | 10 71 | | 349 75 | 233 21 |
| 10 60 | | 6 90 | | 340 75 | 205 17 |
| 10 70 | | 10 66 | | 205 80 | 222 38 |
| 191 85 | | 290 49 | | 280 75 | 180 4 |
| 255 30 | | 0 46 | | 290 75 | 197 11 |
| 240 70 | | 265 85 | | 195 60 | 196 9 |
| 70 89 | | 5 85 | | 46 76 | 193 1 |
| 194 70 | | 100 56 | | 310 60 | 186 7 |
| 175 60 | | 150 82 | | 310 90 | 159 17 |
| 70 70 | | 144 85 | | 180 86 | |
| 50 80 | | 200 80 | | 194 75 | |
| | | 130 85 | | 190 57 | |
| | | 45 84 | | 193 84 | |
| | | 330 15 | | 183 36 | |
| | | 340 40 | | 185 80 | |
| | | 180 83 | | 151 64 | |
| | | 326 75 | | | |
| | | 310 75 | | | |
| | | 1 75 | | | |
| | | 176 85 | | | |
| | | 31 65 | | | |
| | | 141 35 | | | |
| | | 341 70 | | | |
| | | 320 75 | | | |
| | | 340 85 | | | |
| | | 260 80 | | | |

| dextral faults- barren | normal faults- mineralized | normal faults- mineralized- slickensides | normal faults- barren | reverse faults- barren |
|---|---|---|---|---|
| 41 70 | 275 65 | 21 64 | 197 80 | 38 78 |
| 67 60 | 280 80 | | 150 80 | 354 35 |
| 58 51 | | | 176 62 | 347 45 |
| 66 54 | | | 22 60 | |
| 49 49 | | | 186 69 | |
| 207 80 | | | 207 88 | |
| 51 80 | | | 132 54 | |
| 51 60 | | | 193 30 | |
| 70 75 | | | 148 35 | |
| 246 75 | | | 168 34 | |
| 241 83 | | | 45 60 | |
| 252 89 | | | 26 87 | |
| 254 75 | | | | |
| 248 83 | | | | |
| 71 89 | | | | |

## Girdwood district

*Area*—This area is located up the Crow Creek valley near Crow Pass, near the town of Girdwood.

*Data Sources*—Structural data from this area comes from our examination of several prospects and the compilation of Haeussler and Bradley (1993), which chiefly used Park (1933) and Hoekzema et al. (1987).

*Geologic Setting*—The entire area lies within the Valdez Group. There are several granitic intrusions of the Sanak-Baranof belt present in the area, and these intrusions are not present outside of the area with the gold prospects. This suggests a genetic relationship between the intrusions and the gold mineral occurrences. In general, the dikes are less than 4-m wide, but the prominent dike on the south side of Summit Mountain is perhaps 10-m wide at its maximum. Seven of the nine documented gold mineral occurrences in this area lie near a dike; two of the nine occurrences crosscut a dike or associated hornfels.

*Structural Characteristics*—Although there is some variation, the strike of bedding and cleavage, and the trend of fold axes are northeast-southwest in this part of the Chugach Mountains (see our data on the Moose Pass-Hope area and Winkler, 1992; Tysdal and Case, 1979). However, poles to bedding define a great circle with a subhorizontal pole that trends west-northwest–east-southeast. This orientation is almost perpendicular to the regional structural trends. Cleavage was generally not present in the rocks near these gold occurrences, and only two orientations were recorded—one parallel to the strike of bedding, one not—but both are almost perpendicular to regional trends. This evidence indicates there has been some vertical axis rotation of this area after deformation of bedding and formation of cleavage. The timing of the gold-quartz veins and faults with respect to the vertical axis rotations is not entirely certain. The three dike orientations that we have from this area all have northwesterly strikes. Comparing the orientations of the dikes at Crow Creek to those in other areas, it appears that in general dikes have northeasterly strikes. Therefore, one might conclude that there was vertical-rotation after intrusion of the dikes in order to explain the discrepancy in orientations at Crow Creek compared to regional trends. However, on the geologic map of the area near Crow Creek (Winkler, 1992) there are three dikes shown and all have northerly strikes (we are unsure why these orientations are different than in our compilation). There are also some dikes within 10 km that have northeasterly strikes, but there are also abundant dikes 15 km to the north-northwest that have north-northwesterly strikes, and bedding in the area has a northeast strike. Thus the dikes with the northerly strikes are within an area that has no evidence for vertical axis rotations. It follows that it is hard to demonstrate that the orientations of dikes at Crow Creek are unusual with respect to local structures. Because dike intrusion was just prior to gold mineralization (Haeussler et al., 1995), and because timing of vertical axis rotation at Crow Creek is unconstrained with respect to intrusion of the dikes, there is ambiguity about whether the structures that host the gold should be interpreted within a 'rotated' or 'unrotated' framework.

Despite the uncertainties in orientations due to vertical axis rotations, the characteristics of gold-quartz veins at Crow Creek are identical to those elsewhere. These veins are found within steeply-dipping faults and joints, and are commonly 0.5 m wide, but up to 1.25 m-wide. Most of the gold-quartz veins strike roughly east-west. A few gold-quartz veins were followed that strike approximately north-south. However, the geochemical data in Hoekzema et al. (1987) strongly indicates that more gold was found on the east-west striking veins. These veins are approximately parallel to the strike of local bedding, but steeper, and are also parallel to the strike of nearby dikes. If the veins are only slightly younger than the dikes, then perhaps the same stress regime caused both to develop. All gold-quartz mineralized faults with a known sense of motion are dextral faults with an east-west strike. All (only 2) faults that are not gold-quartz mineralized are dextral faults striking northwest-southeast. If these faults developed after vertical axis rotation, their orientation on a regional scale may be explained by the fact that they are oriented between the orientations of dextral faults in the Moose Pass-Hope area and in the Port Wells area (not much data from Port Wells). However, the non-gold-quartz mineralized faults have gouge consisting of crushed rock fragments and no quartz, and are oriented approximately 30° clockwise of the gold-quartz mineralized veins. These characteristics are much like in the Moose Pass-Hope area, and strengthen the argument that vertical axis rotation in the region around these prospects did occur, and that it occurred after gold mineralization.

We have no record of any sinistral faults and only two normal faults in this area, but these did not host any gold-quartz veins that were followed by miners.

*Cross-Cutting Relationships and Age Constrains*—The felsic intrusion at Crow Pass has a $^{40}$Ar/$^{39}$Ar age on white mica of 54.1 ± 0.1 Ma, and the nearby Jewel Mine has a $^{40}$Ar/$^{39}$Ar age on white mica of 54.3 ± 0.1 Ma (Haeussler et al., 1995). The error bars of these dates overlap each other, which indicates that gold mineralization and intrusion of dikes was essentially coeval. Gold-quartz veins at several unnamed prospects in the Crow Creek area cut across the dike on the southwest side of Summit Mountain (Haeussler, unpublished data; Park, 1933, p. 421). Faulting occurred during gold mineralization, as indicated by veins within faults, and also after gold mineralization as indicated by faulted margins of gold-quartz veins. There are a number of cross-cutting relationships at the Monarch mine. The main mined veins (0.25 to 1 m wide) oriented 280/55-70 and 260/70, cut some smaller (15 cm wide) veins striking ~355 and dipping steeply to the east or west (Haeussler and Bradley (1993) listed this relationship in the reverse order). By inference with other nearby veins, the main vein at the Monarch mine may be a dextral-slip fault. Also, there are gold-quartz veins oriented 004/85 and 003/65 that cut a dike. Finally, the two normal faults (163/70 and 315/70) cut gold-quartz veins oriented 341/22, and a shear zone (022/90) cuts the hornfels of the major intrusion on Summit Mountain.

| bedding | bedding (continued) | cleavage | dikes- new data | dike strikes from Park (1912) | dike strikes from Park (1912) (continued) |
|---|---|---|---|---|---|
| 228 45 | 258 80 | 296 24 | 293 30 | 20 | 354 |
| 284 10 | 243 20 | 328 55 | 283 57 | 31 | 291 |
| 104 48 | 242 90 | | 345 54 | 306 | 26 |
| 129 20 | 268 60 | | 29 75 | 18 | 23 |
| 102 70 | 306 90 | | | 50 | 3 |
| 312 45 | 300 25 | | | 322 | 352 |
| 280 55 | 265 20 | | | 309 | 338 |
| 270 60 | 230 35 | | | 355 | 338 |
| 280 51 | 218 35 | | | 350 | 25 |
| 291 41 | 262 25 | | | 337 | 320 |
| 260 26 | 345 40 | | | 323 | 49 |
| 237 62 | 220 35 | | | 349 | 12 |
| 277 44 | 260 55 | | | 77 | 356 |
| 330 60 | 245 25 | | | 24 | 356 |
| 335 45 | 320 40 | | | 20 | 346 |
| 229 65 | 215 55 | | | 23 | 1 |
| 224 55 | 282 35 | | | 20 | 23 |
| 275 35 | 215 55 | | | 34 | 24 |
| 229 55 | 262 55 | | | 37 | 77 |
| 334 20 | 248 80 | | | 355 | 315 |
| 334 30 | 345 30 | | | 45 | 307 |
| 224 60 | 027 70 | | | 357 | 50 |
| 250 40 | 260 40 | | | 16 | 12 |
| 239 40 | 267 70 | | | 13 | 18 |
| 002 60 | 238 35 | | | 47 | 305 |
| 294 35 | 234 40 | | | 17 | 335 |
| 276 40 | 240 50 | | | 56 | 5 |
| 214 50 | 222 25 | | | 318 | 2 |
| 255 55 | 229 50 | | | 281 | 306 |

(continued)

(continued)

| bedding | bedding (continued) | cleavage | dikes- new data | dike strikes from Park (1912) | dike strikes from Park (1912) (continued) |
|---|---|---|---|---|---|
| 225 60 | 235 25 | | | 331 | 6 |
| 225 65 | 224 70 | | | 67 | 284 |
| 260 55 | 221 20 | | | 46 | 271 |
| 232 60 | | | | 319 | 350 |
| 252 55 | | | | 321 | 47 |
| 056 75 | | | | 324 | 51 |
| 203 45 | | | | 335 | 53 |
| 255 60 | | | | 343 | 94 |
| 333 55 | | | | 340 | 64 |
| 228 80 | | | | 345 | 329 |
| 243 70 | | | | 6 | 73 |
| 323 65 | | | | 262 | 319 |
| 342 35 | | | | 271 | 328 |
| 253 20 | | | | 305 | 331 |
| 238 75 | | | | 354 | 348 |
| 225 60 | | | | 314 | 35 |
| 050 80 | | | | 315 | 24 |
| | | | | 359 | 23 |
| | | | | 284 | 13 |

| quartz veins-mineralized | quartz veins-barren | generic faults-mineralized | generic faults-barren | dextral faults-barren | dextral faults-barren-slickensides | normal faults-barren |
|---|---|---|---|---|---|---|
| 263 55 | 301 28 | 130 40 | 305 69 | 305 69 | 272.9 13.9 | 163 70 |
| 264 64 | 245 73 | 162 80 | 125 50 | 327 55 | 100 44 | 315 70 |
| 251 65 | 328 36 | 280 55 | 304 36 | | | |
| 270 61 | 016 60 | 280 70 | 198 38 | | | |
| 345 70 | 4 85 | 260 70 | 22 90 | | | |
| 325 52 | 3 65 | | | | | |
| 327 49 | | | | | | |
| 271 65 | | | | | | |
| 293 55 | | | | | | |
| 293 70 | | | | | | |
| 284 55 | | | | | | |
| 284 70 | | | | | | |
| 130 40 | | | | | | |
| 330 60 | | | | | | |
| 225 65 | | | | | | |
| 325 80 | | | | | | |
| 297 55 | | | | | | |
| 267 68 | | | | | | |
| 162 80 | | | | | | |
| 280 55 | | | | | | |
| 280 70 | | | | | | |
| 260 70 | | | | | | |
| 355 90 | | | | | | |
| 150 60 | | | | | | |
| 11 70 | | | | | | |
| 280 80 | | | | | | |
| 270 70 | | | | | | |
| 175 90 | | | | | | |
| 175 65 | | | | | | |

## Peters Creek

*Area*—This area covers two gold mineral occurrences at the headwaters of Peters Creek, located about 30 km northeast of Anchorage. If this area were not so geographically isolated from the other gold mineralized areas, these data would hardly be worth mentioning.

*Data Sources*—The data comes from Capps (1916) and is also summarized in Haeussler and Bradley (1993).

*Geologic Setting*—These gold-quartz veins lie in a “flap” of McHugh Complex rocks. A geologic map (Winkler, 1992) shows a swarm of 30 dikes in the area. These prospects appear to be near the southern extent of the swarm. The dikes cross the contact between the McHugh

Complex and Valdez Groups indicating they are younger than the age of juxtaposition of the two units. The dikes are presumably related to the Sanak-Baranof belt of intrusions, and lie within 2 km of the prospects.

*Structural Characteristics*—There is not enough resolution on the map of Winkler (1992) to infer the bedding orientation in the vicinity of these prospects. Two bedding orientations (~050°) are shown within 5 km of the area and these are perpendicular to each other. The swarm of dikes extending northward generally have northerly strikes (~355°). Capps (1916) reports the orientations of two gold-quartz veins; both strike northwest and dip steeply. It is clear from the description that at least one of these veins is in a reasonably well defined fault zone. From the limited description in Capps (1916) it appears these veins are similar to lode-gold mineral occurrences elsewhere in the Kenai and Chugach mountains. The fact that the gold-quartz mineralized fault zone is steeply dipping is consistent with the orientations at other mineral occurrences, and that mineralization was on strike-slip or normal faults.

*Cross-Cutting Relationships and Age Constrains*—These veins cut the McHugh Complex. Although most gold-quartz veins in the Kenai and Chugach Mountains cut the Valdez Group, veins in the Kodiak Island and Seldovia Quadrangle areas also cut the McHugh Complex or correlative rocks.

| generic faults - mineralized | mineralized quartz veins |
|---|---|
| 120 75 | 120 75 |
|  | 283 60 |

## Port Wells

*Area*—This area includes the all the gold mineral occurrences near Port Wells, Passage Canal, Harriman Fiord, Barry Arm, College Fiord, and Esther Island in Prince William Sound.

*Data Sources*—Data come from several USGS publications published between 1909 and 1914, the dissertation of Stüwe (1984), a derivative paper (Stüwe, 1986), a Bureau of Mines evaluation of selected prospects (Hoekzema et al., 1987), the compilation of Haeussler and Bradley (1993), and our own examination of the Granite and Homestake mines. Although Stüwe (1984) has an abundance of structural data he, in general, does not identify the sense-of-motion on the many faults in the area. Most of his data are also available only in graphical format, and thus it was not possible to incorporate it into our database. As Stüwe (1984) has conducted the most thorough examination of the mines and prospects in this area, it is important to compare his data with ours and then make interpretations. There does appear to be some minor differences in Stüwe's (1984) data published in his dissertation, versus what is in his journal article (Stüwe, 1986). Finally, Bol and Gibbons (1992) conducted regional structural mapping in part of the area, and their data provides another check on bedding and cleavage orientations on a large scale, which is what is published in the accompanying paper. As a result, this area has quite a bit of data, but we are unable to provide a unified format in presenting all of it. Our diagrams show our data, that of Stüwe (1984) where we were able to obtain specific attitudes, and that of Hoekzema et al. (1987).

*Geologic Setting*—Almost all of the gold quartz veins lie within rocks of the Valdez Group or within felsic intrusions. The Culross mine (Hoekzema et al., 1987) lies within volcanic rocks of the Orca Group. In this region of Prince William Sound there are a number of 30-35 Ma intrusions in addition to the 50-55 Ma intrusions considered part of the Sanak-Baranof Belt (Tysdal and Case, 1979; Nelson et al., 1985; Bradley et al., 1993; Haeussler et al., 1995). Intrusions of both ages are present in the Port Wells area, but only intrusions with dates between 50 and 55 Ma host lode gold deposits. Dikes are locally abundant, and the larger intrusions are generally circular in shape and are not elongated. The Esther Island gabbro, one of the 35 Ma intrusions, is unique for its mafic character and it is internally deformed. The other intrusions are all granitic and do not show pervasive deformation.

*Structural Characteristics*—Stüwe (1984) has by far the greatest quantity of bedding and cleavage attitudes in this area. This data shows that bedding generally strikes northeast-southwest. Poles to bedding form a well-defined girdle that trends northwest-southeast. This implies that fold axes are shallowly dipping and strike northeast or southwest. All of this is consistent with regional structural trends. We obtained no bedding and cleavage data from our examination of the Homestake and Granite mines. Haeussler and Bradley (1993) list very little bedding and cleavage data; it is similar to Stüwe’s (1984) data. Bol and Gibbons’ (1992) data from the southeastern part of this area also show that bedding generally strikes northeast-southwest.

Data on dike orientations comes from the compilation of Haeussler and Bradley (1993) and from Stüwe (1984), which indicates that dikes in the Port Wells area generally strike north-northeast–south-southwest and are steeply dipping. Dike orientations on a regional geologic map corroborate this data (Winkler, 1992).

Stüwe (1986) divides up the quartz veins in this area into three types. Type 1 are the oldest veins and are boudinage-related veinlets cutting competent beds and veinlets paralleling the structural fabric. These veins are similar in timing and somewhat similar in structural style to the veins we describe in the Nuka Bay area that are roughly perpendicular to bedding and have subhorizontal quartz fibers. It is interesting that Stüwe (1986) implies an earlier generation of veins, but he does not name or describe them. Goldfarb et al. (1986) refer to these early, bedding-parallel veins as metamorphic quartz segregation features, and indicate that these veins are common throughout the Kenai and Chugach Mountains. Our observations concur. Stüwe’s (1986) Type 2 veins are the gold-quartz veins described above. He refers to these as ‘joint-related discordant veins’. Stüwe (1986, p. 294) also states, “Late in the type-2-vein emplacement stage long, narrow, and irregular veinlets were formed. These veinlets crosscut older type-2 veins, bedding, schistosity, and dikes. They have no consistent directions and occur as networks, stockworks, and healed fracture fillings in most parts of the mining district.”

The mined gold-quartz veins in the Port Wells area are within high-angle faults and fractures, typically less than 1 m wide and 50 meters long, and are rarely up to ~2 m wide and 300-m long. Seventeen of the 45 mineral occurrences that we have a record of are located within a couple hundred meters of an intrusion, and eleven gold-quartz veins cut an intrusion. About half (19) of the gold-quartz veins are demonstrably within a fault. In contrast, Stüwe (1984) remarked that these veins are generally not in faults, but he noted that the gold-quartz vein orientations are similar to his measurements of joint orientations. Our data from the Granite and Homestake mines, in addition to Stüwe's (1984) data from throughout the area, show that most gold-mineralized quartz veins strike northwest-southeast and are steeply dipping. However, Stüwe (1986) and the compilation of Haeussler and Bradley (1993) shows that most mined gold-quartz veins strike northeast-southwest. It is clear from a close look at the data that there were significant gold-quartz veins with both orientations (see also Stüwe, 1986). For example, the Granite Mine has gold-quartz veins (that are dextral faults) oriented northwest-southeast. Stüwe (1986) also plots what he calls Type 1 quartz veins, which are "boudinage-related veinlets cutting competent beds and veinlets paralleling the structural fabric" (p. 293). He includes all unmineralized veins in this group. This helps to explain the difference in orientation between gold-bearing veins (he refers to them as Type 2) and the other veins. Perhaps these type 1 veins are related to the ones perpendicular to bedding and pre-intrusion in the Nuka Bay area.

The data in Bol in Gibbons (1992) and in the compilation of Haeussler and Bradley (1993) show that most faults (that often host the gold-quartz veins) usually have north-northeast to northwest-southeast strikes. The limited new data we collected support this contention. Stüwe (1984, 1986) plots joints and faults together, which is less useful for understanding the regional tectonics. We measured three dextral faults with northwest strikes, but the compilation of Haeussler and Bradley (1993) also lists one northeast-striking dextral fault. Stüwe (1984) states there is "right lateral displacement and minor dip-slip movement" on the faults, but he does not indicate what orientation the faults are. Tysdal and Case (1979) state there is right-lateral movement on the Port Wells fault, but Stüwe (1984) was unable to verify this. We found one north-northwest-striking gold-quartz mineralized sinistral fault and one shallow southeast-dipping sinistral fault with quartz veining. We measured a number of north-south striking normal faults with steep easterly dips that are both gold mineralized and barren. There were no reverse faults observed.

*Cross-Cutting Relationships and Age Constrains*—The gold-quartz veins in this area must be younger than the host Valdez Group rocks, and in all cases, the gold-quartz veins cut intrusions in the area. Haeussler et al. (1995) obtained a $^{40}$Ar/$^{39}$Ar Ar analysis on white mica from the Granite Mine. Although the sample was partly contaminated with chlorite and the analysis had an argon loss spectra, the indications were that the age of mineralization was ≥53 Ma. In addition, a less-than-ideal $^{40}$Ar/$^{39}$Ar analysis on biotite from the intrusion at the Granite Mine had an age of 56 ± 1 Ma; and a good $^{40}$Ar/$^{39}$Ar analysis on white mica from the intrusion at the Homestake Mine has an age of 52.8 ± 0.1 Ma. Because most intrusions in this area are 30-35 Ma, and because gold lodes locally cut compositionally similar, but undated, intrusions, Stüwe (1986) considered the lodes to be Miocene in age. Haeussler et al. (1995) demonstrated that at least two of these lodes and probably all others are 50–55 Ma. The only mineral occurrence that is questionably younger is the prospect of Fish, Collins, and Stewart located on Esther Island (Johnson, 1914). This prospect lies in the margin of the Esther Island pluton, which has been dated as 35.5 ± 0.9 Ma by K-Ar on biotite (Lanphere, 1966). The description of the Fish, Collins, and Stewart prospect supplied by Johnson (1914) does not indicate that it is structurally different than any other prospect in the Kenai and Chugach Mountains, and it is possible that these gold-quartz veins formed before intrusion of the Esther Island pluton. The only cross-cutting relationship we are aware of between different fault sets or gold-quartz veins, is in Harriman Fiord where Stüwe (1984) recognized an older sulfide-mineralized vein (221/65) cut by a younger barren drusy white vein (244/86). The fact that both veins are similar in orientation to veins elsewhere, such as in the Moose Pass-Hope area, and that the younger veins are clockwise of the older veins, suggests similar structural histories in both areas during veining. The paucity of cross-cutting relationships may be due to a higher percentage of the gold-quartz veins lying in joints rather than in faults—in comparison to other areas (35% versus 50% or more, based on Haeussler and Bradley, 1993).

| bedding | cleavage | quartz veins-mineralized | quartz veins-mineralized (continued) | quartz veins-barren | generic faults-mineralized |
|---|---|---|---|---|---|
| 318 54 | 215 73 | 13 62 | 240 70 | 11 50 | 240 58 |
| 110 49 | 210 80 | 108 38 | 26 45 | 12 42 | 240 60 |
| | 225 74 | 33 30 | 26 50 | 33 30 | 190 90 |
| | | 310 65 | 206 70 | | 10 90 |
| | | 296 55 | 255 60 | | 15 90 |
| | | 336 65 | 290 43 | | 218 25 |
| | | 343 60 | 310 55 | | 187 85 |
| | | 315 58 | 290 45 | | 202 90 |
| | | 340 81 | 310 60 | | 243 60 |
| | | 355 83 | 103 55 | | 230 43 |
| | | 199 80 | 311 65 | | 252 55 |
| | | 204 80 | 30 80 | | 192 80 |
| | | 197 80 | 30 90 | | 40 70 |
| | | 235 70 | 120 80 | | 277 90 |
| | | 240 58 | 264 85 | | 210 70 |
| | | 240 60 | 264 90 | | 240 70 |
| | | 210 80 | 154 73 | | 26 45 |
| | | 190 90 | 160 67 | | 26 50 |
| | | 10 90 | 320 77 | | 206 70 |
| | | 15 90 | 345 90 | | 255 60 |
| | | 199 87 | 5 75 | | 290 43 |
| | | 239 75 | 7 80 | | 310 55 |
| | | 187 85 | 0 50 | | 30 80 |
| | | 202 90 | 315 20 | | 30 90 |
| | | 243 60 | 315 60 | | 0 50 |
| | | 245 60 | 190 50 | | 21 90 |
| | | 190 60 | 309 60 | | 40 90 |
| | | 220 60 | 21 90 | | 11 90 |
| | | 192 80 | 40 90 | | 240 60 |
| | | 255 60 | 11 90 | | 240 70 |
| | | 230 43 | 304 90 | | 245 55 |
| | | 252 55 | 145 45 | | 250 90 |
| | | 334 45 | 260 75 | | 220 75 |
| | | 334 50 | 240 70 | | |
| | | 317 40 | 260 60 | | |
| | | 350 40 | 250 70 | | |
| | | 247 55 | 245 55 | | |
| | | 344 45 | 250 90 | | |
| | | 337 52 | 60 77 | | |
| | | 210 70 | 70 85 | | |
| | | | 200 90 | | |
| | | | 220 75 | | |

| dikes | generic faults-barren | dextral faults-mineralized | dextral faults-mineralized-slickensides | sinistral faults-mineralized | sinistral faults-mineralized-slickensides |
|---|---|---|---|---|---|
| 214 85 | 230 85 | 310 65 | 93.4 28.8 | 340 81 | 158.6 8.9 |
| 255 55 | | 296 55 | 143.7 29.8 | | |
| | | 343 60 | | | |
| | | 53 85 | | | |

| sinistral faults-barren | sinistral faults- barren-slickensides | normal faults-mineralized | normal faults-mineralized-slickensides | normal faults-barren | normal faults-barren-slickensides |
|---|---|---|---|---|---|
| 033 30 | 186.4 14.5 | 13 62 | 158.2 47 | 11 50 | 122.2 48 |
| | | 108 38 | 12.2 51.7 | 12 42 | 120.5 40.5 |
| | | 336 65 | | | |
| | | 355 83 | | | |
| | | 248 75 | | | |

## Port Valdez

*Area*—This area includes all lode-gold mineral occurrences in the Port Valdez area. This is a distinct group of deposits from those in the Port Wells area and those near McKinley Peak, near Cordova.

*Data Sources*—The most complete study of this area is by Pickthorn (1982), which had an emphasis on fluid inclusions and stable isotopes of the district. Additional significant studies include Hoekzema et al. (1987), Brooks (1912), and Johnson (1915). The compilation of Haeussler and Bradley (1993) includes all relevant references to this area. We visited the Ruff and Tuff and Cliff mines in this area, and at the Cliff mine we were only able to examine the entrance area of the mine.

*Geologic Setting*—Most all of the gold-quartz vein occurrences are hosted by rocks of the Valdez Group. In addition, there are eight gold-mineral occurrences that are within the Orca Group; seven of these eight are close to the inferred contact with the Valdez Group. There are no large intrusions in this region, and it is notable that of the 57 gold-mineral occurrences for which we have structural data, only two of these have gold-quartz veins that cut an intrusion.

*Structural Characteristics*—Bedding and cleavage in the Port Valdez region both have east-west strikes (actually slightly more east-northeasterly) and steep dips toward the north. As the strike of bedding and cleavage generally parallel the axis of the Kenai and Chugach Mountains, these attitudes are close to the west-northwest strikes that one would expect. We have no information on the orientations of the rare dikes in this region. Although we visited the Ruff and Tuff mine that cuts an intrusion, the contact between the intrusion and the country rocks was covered beneath snow. Gold-quartz veins generally have northwest-southeast strikes (although they range between north-south and east-west) and dip steeply between 50 and 90 degrees. At least 24 of the 57 gold-mineral occurrences for which we have some structural data (Haeussler and Bradley,

1993) are apparently hosted by faults. Gold-quartz mineralized generic faults generally strike east-west. This is a bit surprising, because most of the gold-quartz vein orientations are northwest-southeast. Sense-of-offset information is only available for a few faults in this area. Two dextral faults are steeply dipping and strike northwest-southeast, like the gold-quartz veins. Pickthorn (1982, p. 24 and 27) states, “District-wide, these crosscutting features show a consistent 2 to 3 meters of right lateral movement, the majority of which occurred before veining and mineralization (see Alice Mine map). These are commonly offset by or terminate at left lateral bedding/foliation shears. Offset along these shears was approximately 10 to 12 meters at the Ramsay Rutherford and Hercules mines.” Pickthorn (1982) makes it sound as if these northwest-striking dextral faults are common, which may be the case, but they are not mentioned in other descriptions of the Ramsay Rutherford or Hercules mines, nor elsewhere. His Alice Mine map that he refers to shows no (right-lateral) faults. In addition, he makes it sound as if the post-mineralization sinistral faults (that strike northeast according to Figure 6 in his thesis, or possibly due north according to Figure 7 in his thesis) are common. There is also no mention of such faults elsewhere in the literature that pertains to this region. However, similar late faulting is common in the other gold districts described above, but the sense-of-motion and orientation of the late faults is different. These latter differences might be due to the Port Valdez region being located on the east limb of the southern Alaska orocline.

Pickthorn (1982, p. 24) also stated that gold-bearing veins in the Shoup Bay area “form two well defined groups striking N40°-60°W and N20°-40°E; in the mineral Creek area the fissures strike N30°-50°W and N70°W to east-west” (p. 24) and he quotes Brooks (1912) as the source. In the compilation of structural data by Haeussler and Bradley (1993), which includes Brooks (1912) data, there are no veins that have orientations of N20°-40°E. Pickthorn (1982, p. 35) further notes that there may be up to six generations of quartz veins, but only three are important to understanding gold mineralization. These are: “(1) metamorphic segregation veins, and (2) quartz veins directly associated with gold mineralization. The third type of veins is younger than gold mineralization and occurs as thin drusy coatings and fillings along late stage joints. These joints cut and commonly slightly offset the metamorphic and mineralized veins.” This sounds very similar to the structural sequence elsewhere. In a rose diagram, Pickthorn (1982, p. 29) shows the late stage joints to have a dominant north-south strike.

The Donohue Mine in the Port Valdez area deserves special mention in that it is the only gold mineral occurrence in all of the areas discussed in this paper in which the main gold-mineralized vein appears to be ductilly folded. In a photograph by Steven Nelson (personal communication, 1994) it can be seen that the vein is folded into a broad S shape at one place along the vein. The Bureau of Mines database on mines had no mention of the fold, and the fold did not seem to influence development of the mine.

*Cross-Cutting Relationships and Age Constrains*—As outlined above, only two of the 57 gold mineral occurrences in this area occur near an intrusion, and in both cases the veins are younger than the intrusions. Winkler et al. (1981) obtained a K-Ar date of 51.6 ± 1.5 Ma on muscovite from the Ruff and Tuff mine. Haeussler et al. (1995) performed $^{40}$Ar/$^{39}$Ar analysis on a sample of hydrothermally altered tonalite adjacent to the mineralized zone at the Ruff and Tuff mine. The analysis was less than ideal for an age determination and showed an argon-loss spectra. Interpretation of this data suggests the age of the hydrothermal event is approximately $\geq$ 53 Ma.

The other cross-cutting relationships are mostly outlined above: Pickthorn (1982) describes left-lateral faults, subparallel to bedding, that offset gold-bearing quartz veins that are within right-lateral faults. If these relationships are correct, then the northwest-striking gold-quartz veins are dextral, and the slightly younger sinistral faults would have approximately east-west strikes. In a cartoon, Pickthorn (1982) shows bending of the gold-quartz veins/dextral faults into the sinistral faults. This suggests that deformation occurred under conditions that would allow minor ductile deformation. There are a few other documented cross-cutting relationships, but the sense of motion on the cross-cutting structures is not noted. Johnson (1915) reports that a fault striking 074 cuts a gold-quartz vein and fault oriented 120/50-60 at the Gold King mine. If the northeast striking fault is sinistral and the northwest striking fault dextral, this data fits Pickthorn's (1982) model. Johnson (1915) and Hoekzema (1987) both describe faults oriented 281-290/80 as cutting the main gold-quartz vein/fault oriented 315-330/80-85 at the Ramsay-Rutherford mine. If Pickthorn's (1982) assertions about the structural history of this area are correct, the gold-quartz veins are along dextral faults and the cross-cutting features are sinistral faults. Finally, north-south striking late-stage joints cross all other structures, according to Pickthorn (1982).

| bedding | cleavage | cleavage (continued) | generic faults - mineralized | generic faults - barren |
|---|---|---|---|---|
| 280 50 | 280 50 | 280 70 | 120 50 | 200 60 |
| 280 60 | 280 60 | 278 60 | 120 60 | 29 85 |
| 290 50 | 290 50 | 250 70 | 261 75 | 77 20 |
| 290 60 | 290 60 | 271 75 | 259 75 | 275 90 |
| 245 62 | 77 75 | 271 85 | 255 80 | 290 80 |
| 252 62 | 254 75 | 277 75 | 215 55 | 281 90 |
| 245 90 | 240 70 | 277 85 | 270 40 | |
| 252 90 | 240 77 | 85 90 | 270 60 | |
| 240 70 | 260 70 | 290 70 | 170 70 | |
| 260 70 | 260 77 | 290 80 | 170 80 | |
| 240 77 | 264 75 | 320 70 | 255 90 | |
| 260 77 | 265 80 | 320 80 | 125 70 | |
| 264 75 | 248 62 | 281 80 | 130 90 | |
| 265 80 | 248 66 | 285 90 | 260 70 | |
| 265 55 | 268 62 | 271 90 | 297 90 | |
| 250 60 | 268 66 | 285 60 | 276 90 | |
| 271 75 | 250 50 | 265 45 | 293 90 | |
| 271 85 | 250 70 | | 275 60 | |
| 277 75 | 260 50 | | 290 90 | |
| 277 85 | 260 70 | | 298 90 | |
| 255 75 | 279 70 | | 309 90 | |
| 293 63 | 275 45 | | 80 80 | |
| 285 60 | 280 60 | | 250 63 | |
| | 271 65 | | 260 55 | |
| | 279 75 | | 260 63 | |
| | 258 70 | | 268 55 | |
| | 240 60 | | 268 63 | |
| | 260 60 | | 155 50 | |
| | 190 60 | | 155 70 | |
| | 260 40 | | 315 30 | |
| | 265 52 | | 45 75 | |
| | 257 60 | | 281 60 | |
| | 267 63 | | 279 60 | |
| | 255 65 | | 87 73 | |
| | 255 75 | | 80 75 | |
| | 260 75 | | 120 70 | |
| | 260 65 | | 347 90 | |
| | 260 70 | | 359 80 | |
| | 280 65 | | 355 80 | |

| quartz veins- mineralized | quartz veins- mineralized (continued) | dextral faults- mineralized | dextral faults- mineralized- slickensides | sinistral faults- barren | Sinistral faults- barren- slickensides |
|---|---|---|---|---|---|
| 330 50 | 165 90 | 120 80 | 147.2 10.0 | 055 80 | 233.8 6.9 |
| 340 50 | 335 60 | 147 89 | 120.9 4.9 | | |
| 330 45 | 315 30 | | | | |
| 250 60 | 300 50 | | | | |
| 120 50 | 310 85 | | | | |
| 120 60 | 135 85 | | | | |
| 257 65 | 145 85 | | | | |
| 257 70 | 335 70 | | | | |
| 275 70 | 302 90 | | | | |
| 85 80 | 157 60 | | | | |
| 78 70 | 157 90 | | | | |
| 264 85 | 313 90 | | | | |
| 295 65 | 320 90 | | | | |
| 110 55 | 45 75 | | | | |
| 295 55 | 235 70 | | | | |
| 288 72 | 238 80 | | | | |
| 298 55 | 260 70 | | | | |
| 215 55 | 260 80 | | | | |
| 170 70 | 280 65 | | | | |
| 170 80 | 280 70 | | | | |
| 255 90 | 260 70 | | | | |
| 125 70 | 358 50 | | | | |
| 125 90 | 358 80 | | | | |
| 130 90 | 281 60 | | | | |
| 130 70 | 279 60 | | | | |
| 122 70 | 87 73 | | | | |
| 122 80 | 80 75 | | | | |
| 260 70 | 258 70 | | | | |
| 297 90 | 38 90 | | | | |
| 293 90 | 261 81 | | | | |
| 280 60 | 260 80 | | | | |
| 359 85 | 260 90 | | | | |
| 298 90 | 300 70 | | | | |
| 343 80 | 250 70 | | | | |
| 309 90 | 100 65 | | | | |
| 258 70 | 140 80 | | | | |
| 351 75 | 185 66 | | | | |
| 344 65 | 120 70 | | | | |
| 85 70 | 85 90 | | | | |
| 80 80 | 300 90 | | | | |
| 250 63 | 330 90 | | | | |
| 350 55 | 335 82 | | | | |
| 295 75 | 359 82 | | | | |
| 337 75 | 155 70 | | | | |

(continued)

(continued)

| quartz veins-mineralized | quartz veins-mineralized (continued) | dextral faults-mineralized | dextral faults-mineralized-slickensides | sinistral faults- barren | Sinistral faults- barren-slickensides |
|---|---|---|---|---|---|
| 115 85 | 179 70 | | | | |
| 157 85 | 35 82 | | | | |
| 260 55 | 45 82 | | | | |
| 260 63 | 315 85 | | | | |
| 268 55 | 330 85 | | | | |
| 268 63 | 315 80 | | | | |
| 330 65 | 315 85 | | | | |
| 320 65 | 332 90 | | | | |
| 133 48 | 330 90 | | | | |
| 152 48 | 314 90 | | | | |
| 155 50 | 350 90 | | | | |
| 155 70 | 174 70 | | | | |
| 145 50 | 355 80 | | | | |
| 145 80 | 220 60 | | | | |
| 153 50 | 147 89 | | | | |
| 153 80 | 146 60 | | | | |
| 165 80 | 270 67 | | | | |
| 270 67 | 220 70 | | | | |
| 220 70 | | | | | |

## McKinley Peak

*Area*—This area includes all the gold prospects in the McKinley Peak area, which is located about 30 km east of the town of Cordova. All the prospects are within a small area and are not widely dispersed.

*Data Sources*—There is structural data for only five gold-mineral occurrences, and all of it comes from the thesis of Haney (1982). Haney (1982) mapped a small area (about 10 km$^2$) between the McKinley Peak pluton and the gold prospects on its southeast side. We visited the site of the so-called “stringer adit” in the Lucky Strike group of mines, but the adit was collapsed and vegetation obscured a more thorough investigation. We examined the tailings pile and a nearby outcrop.

*Geologic Setting*—All these gold-quartz veins are hosted by the Paleocene-Eocene Orca Group, and lie within 1.3 and 2.5 km of the McKinley Peak pluton, which has been dated by K-Ar on biotite as 51.4 ± 1.5 Ma (Plafker in Wilson et al., 1991), and on phlogopite as 51.6 ± 2 Ma (Winkler and Plafker, 1981). The McKinley Peak pluton is a biotite-hornblende granodiorite (Winkler and Plafker, 1993) and is elongate in a northeast-southwesterly direction; its dimensions are approximately 15 x 4 km.

*Structural Characteristics*—Bedding and cleavage in the area around McKinley Peak generally have west-northwest strikes as shown by the data on stereonets and maps by Winkler and Plafker (1993) and Haney (1982). Haney’s (1982) mapping shows bedding attitudes close to the margin of the McKinley Peak pluton as striking northeast-southwest, and then moving southeastward away from the pluton, the bedding strikes northwest-southeast. There are two ways to interpret this data. The bedding near the pluton may have been rotated into parallelism with the margin of the pluton during emplacement, or the attitudes near the margin are representative of the regional structures and those near the gold prospects have an unusual orientation. The fact that fold axes within ~1 km of the pluton are reportedly plunging between 70 and 80 degrees suggests there was some deformation of the country rocks during intrusion of the pluton. Bol and Roeske (1993) suggest there was regional deformation during emplacement of the plutons in this region because the plutons parallel the regional strike of cleavage, which also parallels the major bays in the area, which are probably faults.

The mapping by Haney (1982) also shows a number of inferred east-west striking and steeply north dipping thrust faults. These thrusts are shown on his cross sections as disrupting the hinge region of a large isoclinal fold. He illustrates the end result as four synclines all in fault contact with each other. If the interpretation is correct, all three faults are thrusts, and these would postdate the ductile folding of the rocks. On Haney's (1982) map, three of these faults can be traced for about a two kilometers. These faults are somewhat similar in orientation to the regional-scale faults trending northeast-southwest and extending southwestward to Hawkins, Hinchinbrook, and Montague Islands.

The documented gold-quartz veins in this area are less than 35 cm in width and less than 22 m in length. One of the mineralized samples in the float at the Lucky Chance mine that we observed had slickensides on it, indicating some brittle faulting after gold mineralization. This relationship is consistent with other places. We have orientation data on only seven quartz veins, and perhaps these have a bimodal distribution. Several have a northwest-southeast strike and have a similar orientation to bedding. There are also a few gold-quartz veins with a northeast-southwest strike and a steep southwesterly dip. Their relationship to the other veins is uncertain. There is no data on the relationship of any fault sets to mineralization. Haney (1982) also describes a number of quartz veins that have a bedding-parallel orientation and are clustered in fold hinges. These sound like the metamorphic segregation veins described by Goldfarb et al. (1986). The main gold-quartz vein followed at the Lucky Strike mine has a similar orientation—and also sounds like a fault, but because the beds are isoclinally folded, and steeply dipping, steeply dipping late faults and joints could easily have the same orientation as bedding-parallel metamorphic-segregation veins. Haney (1982) also notes that the quartz veins are less common in graywacke and tend to be perpendicular to bedding and thicker (average 2") than those in the slate. The veins in the graywacke appear analogous to Stüwe's (1986) "Type 1" veins in the Port Wells district and to the veins we observed in the Nuka Bay area with subhorizontal quartz fibers. If this correlation is correct, these veins are older than the gold-quartz veins.

Bol and Roeske (1993) published a small amount of structural data on late faults in a 1,800 km$^2$ area that includes Cordova and the McKinley Peak district. Their data may place some constraints on the structural regime in the McKinley Peak area. The only faults they map that parallel the northeast-southwest striking gold-quartz veins are sinistral faults. The northwest-southeast striking gold-quartz veins could be associated with dextral, normal, or reverse faults that they mapped. If the connection between sinistral faults and gold-quartz veins is correct, than by inference the northwest-southeast striking veins may be related to dextral faults with the same orientation. The dextral and sinistral fault sets appear to form a conjugate set.

We obtained a limited amount of structural data from the McKinley Peak pluton from a quarry exposure. The high-temperature magmatic foliation strikes east-west and dips steeply north.

There are some normal-motion brittle-ductile shear zones that cut the intrusion with greenschist-facies minerals along them. Several of these shear zones (but only one was measured), had an orientation similar to the east-northeast–west-southwest striking magmatic foliation in the pluton. Finally, a brittle normal fault had a similar northeast-southwest strike, and the two normal faults that Bol and Roeske (1993) measured had east-west strikes. There were some other brittle faults in the intrusion that had well defined slickensides, but poorly defined sense of offset. These are also strike-slip faults with strikes at a high-angle to the strike of the normal fault. One can imagine these faults as forming a conjugate set with north-northwest–south-southeast directed extension. All this data is consistent with there being an orthorhombic fault set that deformed the pluton once it had cooled. The similarity of the high-temperature magmatic foliation with the orientation of the normal-motion brittle-ductile shear zones and the brittle normal fault suggests a similar, northwest-southeast directed, extensional strain regime during intrusion and cooling of the pluton.

*Cross-Cutting Relationships and Age Constrains*—There are virtually no cross-cutting relationships to discuss for this area. The gold-quartz veins are younger than the host Orca Group rocks. Limited fluid inclusion work by Haney (1982, p. 32) led him to state, “The similarity of fluid inclusions in all rock-types suggests post-intrusion mineralization of the area.” However, the quality of the fluid inclusion data is poor and such an interpretation is not well supported. Haeussler et al. (1995) demonstrated that gold-mineral occurrences in the southern Alaska accretionary complex are slightly younger than nearby near-trench intrusions. Based on this general relationship, it is likely the gold-mineral occurrences are similar in age, but slightly younger than the nearby McKinley Peak pluton.

| bedding | cleavage | generic faults - mineralized | mineralized quartz veins |
|---|---|---|---|
| 285 59 | 319 61 | 280 60 | 280 60 |
| 291 62 | | | 60 90 |
| 271 51 | | | 55 44 |
| 271 86 | | | 310 90 |
| 272 45 | | | 46 44 |
| 275 58 | | | 312 90 |
| 282 71 | | | 305 67 |
| 279 69 | | | |
| 274 30 | | | |
| 310 70 | | | |
| 313 66 | | | |
| 298 57 | | | |
| 317 55 | | | |
| 330 56 | | | |
| 305 67 | | | |
| 335 42 | | | |

## Chichagof District

*Area*—This area includes all the gold mineral occurrences in the Chichagof district on and near the abandoned village of Chichagof on Chichagof Island in southeastern Alaska. This is approximately 125 km southwest of Juneau, Alaska. The two principal mines in the area were the Chichagof and the Hirst-Chichagof mines.

*Data Sources*—Structural data comes almost entirely from the excellent report of Reed and Coats (1941). Their report only lacks kinematic data, which we collected in visits to the Chichagof and Hirst-Chichagof mines. Dadoly (1987) provided a limited amount of structural information about the mine. Decker (1980) has regional bedding, cleavage, and joint orientations not included in, but consistent with, our summary; Johnson and Karl (1985) have some bedding and cleavage orientations we included in our summary.

*Geologic Setting*—All these gold-quartz mineral occurrences are hosted by the Cretaceous(?) Sitka Graywacke as mapped by Johnson and Karl (1985). There are also aplite dikes present; these are cut by gold-quartz veins. All the mines are within steeply dipping northwest-southeast striking fault zones, which will be discussed below.

*Structural Characteristics*—Bedding, both overturned and upright, and cleavage have southeast to east-southeast strikes and steep dips. The two bedding and cleavage intersections we measured have west-southwesterly trends and a moderate plunge. The fact that regional bedding and cleavage strikes are northwest-southeast (Johnson and Karl, 1985) suggests that the southwest plunging bedding and cleavage intersection lineations are unusual, and that northwest-southeast fold axes are probably typical. Virtually all gold-quartz veins are within faults that have steep southwesterly dips and northwest-southeast strikes. A few are within either faults or joints that strike northeast-southwest and dip steeply north. These veins are oriented at a high-angle to the main northwest-southeast striking fault/vein systems that were the focus of gold exploration (Reed and Coats, 1941). The Chichagof and Hirst-Chichagof mines are both located on northwest-striking faults that have geomorphic expression. There are abundant slickensides, which plunge ~30° to the southeast, and show these faults are reverse-dextral faults. Because most all the mineralized faults have the same orientation, they are probably all reverse-dextral faults. The total amount of throw on the Chichagof fault is estimated to be more than 330 m (Reed and Coates, 1941). As in all the other areas, there are faults with gold-quartz veins that cut intrusions of the Sanak-Baranof belt. However, it is clear that there was faulting *prior* to aplitic dike intrusion along the Hirst-Chichagof fault, as indicated by a dike intruded between layers of banded quartz (Reed and Coats, 1941, plate 23). The dike is then cut by the fault and by gold-quartz veins. This relationship demonstrates that faulting, gold-mineralization, and intrusion were coeval. Fault zones with gouge and no quartz veins cut all gold-quartz mineralized features. These faults are parallel to the main mineralized faults.

*Cross-Cutting Relationships and Age Constrains*—These gold-quartz veins cut rocks mapped as the Sitka Graywacke by Johnson and Karl (1985), and therefore they must be younger. As described in the preceding paragraph, gold-quartz veining and intrusion of an aplitic dike was coeval in the Hirst-Chichagof mine. In the Chichagof and other mines in the area, the gold-quartz veins cut aplitic dikes. The veins are also cut by later faults, parallel to the gold-quartz veins/faults, that have gouge and no quartz veins within them. There are no radiometric dates of any kind from this district, but there are $^{40}$Ar/$^{39}$Ar dates of: 51.4 ± 1.1 Ma, 52.1 ± 0.1 Ma, and

51.9 ± 0.1 Ma from the Apex and El Nido mines that are located 35 km to the northwest. The Apex and El Nido mines are not hosted by accretionary prism rocks, but rather by some granitic intrusives located landward of the accretionary complex. However, these gold mineral occurrences are most easily related to the gold deposits in the accretionary complex rather than to any other gold mineral occurrences. Thus, it is likely that the age of the Chichagof district gold deposits are approximately 52 Ma.

| bedding | cleavage | dikes | quartz veins- mineralized | quartz veins- mineralized (continued) | generic faults - mineralized |
|---|---|---|---|---|---|
| 103 44 | 94 72 | 150 90 | 161 63 | 211 73 | 122 70 |
| 102 72 | 106 68 | 140 90 | 143 54 | 222 70 | 196 65 |
| 105 61 | 142 75 | 354 85 | 173 55 | 158 50 | 185 62 |
| 146 64 | 113 75 | 174 90 | 130 70 | 140 80 | 0 58 |
| 150 67 | 132 75 | 2 85 | 122 70 | 133 50 | 195 73 |
| 117.6 66.7 | 132 77 | 153 84 | 165 75 | 105 50 | 197 60 |
| 114.6 64.4 | 117 75 | 343 75 | 123 70 | 139 63 | 75 85 |
| 121.8 67.8 | 118 64 | 276 82 | 120 84 | 139 60 | 210 65 |
| 105 80 | 101 75 | 82 80 | 132 84 | 155 50 | |
| 132 43 | 129 67 | 108 80 | 220 70 | 167 69 | |
| 100 35 | 98 73 | 150 86 | 125 63 | 75 85 | |
| 142 50 | 125 50 | | 108 80 | 165 55 | |
| 110 75 | 118 90 | | 185 62 | 132 57 | |
| 123 70 | 111 90 | | 0 58 | 127 80 | |
| 115 70 | 140 90 | | 195 73 | 130 51 | |
| 145 65 | 93 73 | | 197 60 | 210 65 | |
| 135 73 | | | 140 70 | 145 67 | |
| 122 62 | | | 126 62 | 118 52 | |
| 102 75 | | | 155 60 | 115 64 | |
| 116 73 | | | 135 70 | 146 65 | |
| 145 75 | | | 150 73 | 155 75 | |
| 115 60 | | | 145 73 | | |
| 105 65 | | | 135 63 | | |
| 115 70 | | | 340 65 | | |
| 122 68 | | | 165 85 | | |
| 102 50 | | | 172 65 | | |
| 152 50 | | | 151 90 | | |
| 108 69 | | | 120 60 | | |
| 270 46 | | | 220 70 | | |
| 109 56 | | | 215 75 | | |
| 110 58 | | | 225 46 | | |

| joints-mineralized | dextral faults-mineralized | dextral faults-mineralized (continued) | dextral faults-mineralized (continued) | dextral faults-mineralized (continued) | dextral faults-mineralized-slickensides |
|---|---|---|---|---|---|
| 220 70 | 161 63 | 120 84 | 135 70 | 133 50 | 157.8 23.8 |
| 215 75 | 143 54 | 132 84 | 150 73 | 105 50 | 132.5 28.5 |
| 225 46 | 173 55 | 125 63 | 135 63 | 139 63 | 155.3 22.9 |
| 211 73 | 130 70 | 108 80 | 340 65 | 139 60 | 159.7 26.9 |
| 222 70 | 165 75 | 140 70 | 165 80 | 155 50 | 163.5 28.9 |
| 17 75 | 123 70 | 126 62 | 172 65 | 167 69 | |
| | 127 80 | 155 60 | 120 60 | 165 55 | |
| | 109 70 | 145 67 | 158 50 | 132 57 | |
| | 130 51 | 118 52 | 140 80 | | |
| | 146 65 | 155 75 | 115 64 | | |

## Lucky Chance Area

*Area*—This area includes the gold-mineral occurrences in the Silver Bay area southeast of Sitka, and those near the Lucky Chance mine—the largest of the mines and prospects. These lie along a northwest-southeast trend.

*Data Sources*—Data from this area comes from our examination of the regional brittle structural history in this area (Haeussler et al., 1994; and unpublished data), and from Becker (1898), Wright and Wright (1905), and Knopf (1912).

*Geologic Setting*—All of the gold-quartz veins are hosted by rocks of the Sitka Greywacke. We have found a few felsic and diorite dikes in the area.

*Structural Characteristics*—Bedding and cleage both strike northwest-southeast and dip steeply, but whereas bedding dips both to the northeast and the southwest, all of the cleavage orientations have steep southwest dips. Felsic and diorite dikes both have northwest strikes and nearly vertical dips. Quartz veins not inferred to be associated with gold mineralization have somewhat variable orientations, but most have east-southeast strikes and steep southwest dips. Gold-quartz veins at mines and prospects consistently have northwest or west-northwest strikes, and generally dip steeply to the north. Most faults that we observed in this area are northwest striking, steeply dipping, dextral faults. A few faults that have the same orientation, but an unknown sense of offset, are probably also dextral faults. Some east-northeast striking and steeply dipping sinistral faults were also observed at locations away from lode-gold mineral occurrences. These faults do not have the correct orientation and sense of offset to be conjugate to the northwest-striking right lateral faults, indicating they belong to a different, but unknown generation of faulting. We visited the Golden Eagle mine (or Liberty mine) on the southwest shore of Silver Bay, and the Lucky Chance mine. The adit at the Lucky Chance mine was collapsed so we were unable to directly inspect the mine workings. At the Golden Eagle mine we were able to examine the mineralized structure, which was a southeast-striking dextral fault. Because all gold-quartz veins have the same orientation, and because similar southeast-striking dextral faults were found in the vicinity of the Lucky Chance mine, we consider it very likely that most, if not all, gold-quartz mineralized structures in the Lucky Chance area are actually dextral faults.

*Cross-Cutting Relationships and Age Constrains*—All these gold-quartz veins cut rocks of the undated Sitka Greywacke. Haeussler et al. (1995) obtained a $^{40}$Ar/$^{39}$Ar date of 49.4 ± 0.5 Ma on a small sample of sericite separated from quartz in the tailings pile at the Lucky Chance mine.

| bedding | cleavage | cleavage (continued) | dikes | quartz veins-mineralized |
|---|---|---|---|---|
| 307 90 | 304 85 | 334 68 | 350 76 | 110 80 |
| 126 60 | 112 51 | 300 80 | 340 86 | 112 80 |
| 134 78 | 115 77 | 279 47 | 150 75 | 108 80 |
| 114 65 | 124 74 | 280 59 | | 300 70 |
| 314 90 | 111 88 | 305 59 | | 315 70 |
| 345 83 | 125 66 | 82 28 | | 290 89 |
| 325 85 | 129 83 | 325 90 | | 315 80 |
| 130 85 | 295 83 | 283 90 | | 325 40 |
| 328 70 | 125 79 | 300 67 | | 305 89 |
| 65 30 | 135 85 | 85 80 | | |
| 80 78 | 305 66 | 285 60 | | |
| 228 68 | 298 90 | 300 69 | | |
| 325 87 | 280 85 | 295 60 | | |
| 295 90 | 310 75 | 300 65 | | |
| 290 75 | 343 70 | 285 75 | | |
| 330 75 | 280 43 | 280 75 | | |
| | 315 55 | | | |

| dextral faults-barren | dextral faults-barren-slickensides | sinistral faults-barren | sinistral faults-barren-slickensides |
|---|---|---|---|
| 130 80 | 307.0 16.7 | 044 85 | 45.4 15.9 |
| 117 61 | 294.6 4.4 | 256 71 | 265 24.5 |
| 105 65 | 105 0 | 080 44 | 91.4 4.8 |
| 141 68 | 316.4 11.1 | 077 89 | 091.4 4.8 |
| 142 88 | 321.6 12.0 | 090 74 | |
| 141 69 | 307.9 30.6 | | |
| 130 75 | 303.1 24.1 | | |
| 311 82 | 312.5 10.9 | | |
| 311 80 | 311.2 1.0 | | |
| 311 67 | 311.8 1.8 | | |
| 320 89 | | | |
| 313 82 | | | |
| 313 84 | | | |
| 320 73 | | | |
| 310 76 | | | |
| 314 73 | | | |
| 137 78 | | | |

## References CIted

Becker, G.F., 1898, Reconnaissance of the gold fields of southern Alaska, with some notes on general geology: U.S. Geological Survey 18th Annual Report, part 3, p. 1–86.

Bradley, Dwight C., Haeussler, Peter J., and Kusky, Timothy M., 1993, Timing of early Tertiary ridge subduction in southern Alaska: in Till, A., and Dusel-Bacon, C., eds., Geologic studies in Alaska by the U.S. Geological Survey, 1992, U.S. Geological Survey Bulletin 2068, p. 163–177.

Bol, A. J., and Gibbons, H, 1992, Tectonic implications of out-of-sequence faults in an accretionary prism, Prince William Sound, Alaska: Tectonics, v. 11, p. 1288–1300.

Bol, A. J., and Roeske, S. M., 1993, Strike-slip faulting and block rotation along the Contact fault system, eastern Prince William Sound, Alaska: Tectonics, v. 12, p. 49–62.

Brooks, A. H., 1912, Gold deposits near Valdez, U.S. Geological Survey Bulletin 520, p. 108–130.

Capps, S. R., 1916, The Turnagain-Knik region, U.S. Geological Survey Bulletin 642, p. 147–194.

Dadoly, John P., 1987, Gold mineralization in a regional metamorphic terrane: a wall-rock alteration study of the Chichagof and Hirst-Chichagof gold mines, southeast Alaska: M.Sci. Thesis, South Dakota School of Mines and Technology, Rapid City, South Dakota, 100 p.

Decker, J. E., 1980, Geology of a Cretaceous subduction complex, western Chichagof Island, southeastern Alaska: Stanford, Calif., Stanford University, unpublished Ph.D. thesis, 134 p.

Goldfarb, R. J., Leach, D. L., Miller, M. L., and Pickthorn, W. I., 1986, Geology, metamorphic setting, and genetic constraints of epigenetic lode-gold mineralization within the Cretaceous Valdez Group, south-central Alaska, in Keppie, J. D., Boyle, R. W., and Haynes, S. J., eds., Turbidite-hosted gold deposits: Geological Association of Canada Special Paper 32, p. 87–105.

Haeussler, Peter J., and Bradley, Dwight C., 1993, Map and compilation of structural data from lode-gold mineral occurrences in the Chugach-Prince William terrane of southern Alaska: U.S. Geological Survey Open-File Report, 93–325, 53 pp. plus 1 sheet, scale 1: 500,000.

Haeussler, Peter J., Bradley, Dwight C., Goldfarb, Richard J., Snee, Lawrence W., and Taylor, Cliff, 1995, Link between ridge subduction and gold mineralization in southern Alaska: Geology, v. 23, no. 11, p. 995–998.

Haeussler, Peter J., Davis, J. Steven, Roeske, Sarah M., and Karl, Susan M., 1994, Late Mesozoic and Cenozoic faulting at the leading edge of North America, Chichagof and Baranof Islands, southeastern Alaska: Geological Society of America Abstracts with Programs, v. 26, p. A317.

Haney, J. M., 1982, Geology of the McKinley Lake gold prospect area Chugach National Forest south central Alaska, M.S. thesis, New Mexico Institute of Mining and Technology, Socorro, New Mexico, 43 p.

Hoekzema, Robert B., Fechner, Steven A., and Kurtak, Joseph M., 1987, Evaluation of selected lode gold deposits in the Chugach National Forest, Alaska: U.S. Bureau of Mines Information Circular 9113, 62 p.

Johnson, B. I., 1914, Mining on Prince William Sound. U.S. Geol. Surv. Bull. 592G, pp. 236—243.

Johnson, Bertrand. L., 1915, The central and northern parts of the Kenai Peninsula: U.S. Geological Survey Bulletin 587, p. 113–209.

Johnson, B. R., and Karl, S. M., 1985, Geologic map of eastern Chichagof and Yakobi Islands, southeastern Alaska: U.S. Geological Survey Miscellaneous Investigations Map I-1506, scale 1:125,000, 1 sheet, 15 p.

Knopf, Adolph, 1912, The Sitka mining district, Alaska: U.S. Geological Survey Bulletin 504, 32 p.

Lanphere, M. A., I966, Potassium-argon ages of Tertiary plutons in the Prince William Sound region, Alaska, in Geological Survey research 1966: U.S. Geological Survey Professional Paper 550-D, p. D195-D198.

Mitchell, P. A., 1979, Geology of the Hope-Sunrise (gold) mining district, north-central Kenai Peninsula, Alaska [M.S. thesis]: Palo Alto, California, Stanford University, 122 p.

Moore, G. W., 1969, New formations on Kodiak and adjacent islands, Alaska, in Cohee, G. V., Bates, R. G., and Wright, W. B., compilers, Changes in stratigraphic nomenclature by the U.S. Geological Survey, 1967: U.S. Geological Survey Bulletin 1274A, p. A27-A35.

Nelson, S. W., Dumoulin, J. A., and Miller, M. L., 1985, Geologic map of the Chugach National Forest, Alaska: U.S. Geological Survey Miscellaneous Field Studies Map MF-1645-B, 16 p.,1 pI., scale 1:250,000.

Park, C. F., Jr., 1933, The Girdwood District, Alaska: U.S. Geological Survey Bulletin 849-G, p. 381–424.

Pickthorn, W. J., 1982, Stable isotope and fluid inclusion study of the Port Valdez gold district, southern Alaska: Los Angeles, California, University of California, M.S. thesis, 66 p.

Reed, John C., and Coats, Robert R., 1941, Geology and ore deposits of the Chichagof mining district Alaska: U.S. Geological Survey Bulletin 929, 148 p.

Richter, D. H., 1970, Geology and lode-gold deposits of the Nuka Bay area, Kenai Peninsula, Alaska, U.S. Geological Survey Professional Paper 625-B, 16 p.

Silberman, M. L., Mitchell, P. A., and O'Neil, J. R., 1981, Isotopic data bearing on the origin and age of the epithermal lode gold deposits in the Hope-Sunrise mining district, northern Kenai Peninsula, Alaska: U.S. Geological Survey Circular 823-B, p. B81-B84.

Stüwe, K., 1984, Granitoid intrusions and gold-mineralization in the western Port Wells mining district Prince William Sound Alaska, M.S. thesis, Mining University of Leoben

Stüwe, K., 1986, Structural evolution of the Port Wells gold mining district, Prince William Sound, south central Alaska: Implications for the origin of the gold lodes, Mineralium Deposita, v. 21, p. 288–295.

Tuck, R., 1933, The Moose Pass-Hope district Kenai Peninsula, Alaska, U.S. Geological Survey Bulletin, 849-I, p. 460–527.

Tysdal R. G., and Case, J. E., 1979, Geologic map of the Seward and Blying Sound quadrangles, Alaska: U.S. Geological Survey Miscellaneous Geologic Investigation Series Map I-1150, 12 p., 1 pl., scale 1:250,000.

Wilson, F. H., Shew, N., and DuBois, G. D., 1991, Map and tables showing isotopic age data, in The geology of North America: Geological Society of America DNAG Series, v. G-1, scale 1:2,500,000, plate *XX.*

Winkler, G. R., 1992, Geologic map and summary geochronology of the Anchorage 1°x 3° quadrangle, southern Alaska: U.S. Geological Survey Miscellaneous Investigations Map I-2283, scale: 1:250,000, 1 sheet.

Winkler, G. R., and Plafker, G., 1981, Geologic map and cross sections of the Cordova and Middleton Island quadrangles, southern Alaska: U.S. Geological Survey Open-File Report 81–1164, 24 p.

Winkler, G.R., Miller, R.J., MacKevett, E.M., Jr., and Holloway, C.D., 1981, Map and summary table describing mineral deposits in the Valdez quadrangle, southern Alaska: U.S. Geological Survey Open-File Report 80–892-B, scale 1:250,000, 2 sheets.

Winkler, G. R., and Plafker, G., 1993, Geologic map of the Cordova and Middleton Island quadrangles, southern Alaska: U.S. Geological Survey Miscellaneous Investigations Map I-1984, scale: 1:250,000, 1 sheet.

Wright, F.E., and Wright, C.W., 1905, Economic developments in southeastern Alaska, in Brooks, A.H. and others, Report on progress of investigations of mineral resources of Alaska in 1904: U.S. Geological Survey Bulletin 259, p. 47–68.