Attachment A5

Record of Earthquakes

Earthquake Catalogues within the specified area

CATALOGUE OF EARTHQUAKES (1)
(DATA FROM 1901Y TO 1987Y)

No.	D Year	A Month	T Day	E Epicenter Latitude	Longitude	Depth (km)	Magunitude	Distance (km) from Site to Epicenter
1	1901	5	12	39.80N	30.50E	15.00	5.00	419
2	1903	3	29	32.20N	35.40E	10.00	5.60	534
3	1903	4	4	39.00N	28.00E	20.00	5.50	513
4	1903	7	19	35.00N	30.00E	20.00	5.70	319
5	1904	1	1	37.80N	29.10E	20.00	4.80	369
6	1905	4	15	40.20N	29.00E	6.00	5.60	531
7	1905	4	3	39.80N	30.50E	22.00	5.40	419
8	1907	1	22	41.00N	29.00E	12.00	4.50	601
9	1907	8	21	40.70N	30.10E	15.00	5.50	522
10	1908	6	21	40.60N	35.90E	0.00	5.20	516
11	1908	10	30	37.60N	36.80E	0.00	5.40	359
12	1909	2	9	40.00N	38.00E	60.00	6.30	581
13	1909	2	9	40.00N	38.00E	0.00	5.80	581
14	1909	2	10	40.00N	38.00E	0.00	5.70	581
15	1909	2	22	39.00N	37.00E	0.00	5.70	446
16	1910	8	7	37.80N	28.70E	30.00	5.30	402
17	1911	4	30	36.00N	30.00E	180.00	6.10	273
18	1914	5	28	39.84N	35.80E	10.00	5.40	440
19	1914	10	3	37.70N	30.40E	14.00	6.90	260
20	1914	10	3	38.00N	30.00E	15.00	4.70	307
21	1914	10	4	38.00N	30.00E	15.00	4.70	307
22	1914	10	4	38.00N	30.00E	15.00	4.70	307
23	1914	10	4	38.00N	30.00E	15.00	5.00	307
24	1914	10	4	38.00N	30.00E	15.00	4.70	307
25	1914	10	4	38.00N	30.00E	15.00	5.10	307
26	1914	10	4	38.00N	30.00E	15.00	4.50	307
27	1914	10	5	38.00N	30.00E	15.00	4.60	307
28	1914	10	6	38.00N	30.00E	15.00	4.60	307
29	1914	10	8	38.00N	30.00E	15.00	4.80	307
30	1914	10	10	38.00N	30.00E	15.00	4.60	307
31	1914	10	11	38.00N	30.00E	15.00	5.20	307
32	1914	10	13	38.00N	30.00E	15.00	4.50	307
33	1914	10	17	38.00N	30.00E	15.00	4.80	307
34	1915	12	25	36.47N	36.14E	10.00	5.20	284
35	1916	1	24	40.27N	36.83E	10.00	7.10	531
36	1917	6	13	36.00N	28.00E	15.00	4.60	449
37	1918	1	16	38.80N	32.90E	0.00	5.30	248
38	1918	1	16	38.34N	29.48E	10.00	5.70	365
39	1918	8	9	40.89N	33.41E	10.00	5.80	482
40	1918	8	29	40.58N	35.16E	10.00	5.30	485
41	1918	9	29	35.20N	34.70E	0.00	6.50	218
42	1919	5	27	39.13N	31.02E	10.00	5.30	332
43	1919	6	9	40.68N	33.89E	10.00	5.00	464
44	1919	7	18	36.00N	28.00E	15.00	5.20	449
45	1919	7	20	36.00N	28.00E	15.00	4.80	449
46	1919	8	19	35.20N	34.70E	0.00	5.40	218
47	1919	8	24	36.00N	28.00E	15.00	5.40	449
48	1920	5	1	37.00N	28.70E	30.00	5.00	383
49	1920	7	4	37.50N	29.00E	15.00	5.00	367
50	1920	7	4	37.50N	29.00E	15.00	5.20	367

Earthquake Catalogues within the specified area

CATALOGUE OF EARTHQUAKES(2)
(DATA FROM 1901Y TO 1987Y)

No.	D A T E Year	Month	Day	Epicenter Latitude	Longitude	Depth (km)	Magunitude	Distance (km) from Site to Epicenter
51	1920	9	28	37.89N	28.35E	10.00	5.70	434
52	1921	1	16	38.33N	32.79E	10.00	5.70	197
53	1921	1	27	36.00N	28.00E	15.00	5.40	449
54	1921	4	13	38.40N	31.80E	0.00	5.20	228
55	1921	4	20	34.00N	33.00E	0.00	5.20	285
56	1921	5	22	37.00N	28.70E	32.00	5.10	383
57	1921	9	26	38.42N	31.79E	10.00	5.40	231
58	1921	10	5	36.40N	35.20E	0.00	5.50	200
59	1922	2	1	38.00N	37.00E	0.00	5.30	391
60	1922	4	2	34.70N	34.80E	0.00	5.50	266
61	1922	6	3	36.49N	28.65E	30.00	4.90	386
62	1922	8	17	36.00N	28.00E	15.00	5.00	449
63	1922	8	29	37.37N	32.73E	30.00	4.90	92
64	1922	11	20	37.50N	29.00E	28.00	4.90	367
65	1922	12	6	37.50N	29.00E	15.00	5.20	367
66	1923	4	29	40.07N	36.43E	10.00	5.90	493
67	1923	5	29	41.00N	30.00E	25.00	5.50	556
68	1923	9	11	38.00N	29.50E	22.00	4.60	346
69	1924	1	22	39.51N	28.40E	80.00	5.30	516
70	1924	2	18	34.50N	34.00E	0.00	5.80	248
71	1924	2	27	33.00N	36.00E	0.00	5.50	484
72	1924	6	9	35.20N	33.30E	0.00	4.60	155
73	1924	9	10	36.84N	31.49E	30.00	5.00	135
74	1924	11	20	38.55N	30.78E	10.00	5.90	293
75	1924	12	13	38.00N	33.50E	0.00	4.90	166
76	1925	4	4	35.50N	29.00E	15.00	5.00	376
77	1925	4	5	35.06N	29.34E	150.00	5.70	367
78	1925	4	5	35.50N	29.00E	15.00	5.00	376
79	1925	4	5	35.50N	29.00E	15.00	5.60	376
80	1925	4	6	35.50N	29.00E	15.00	4.50	376
81	1925	4	15	35.50N	29.00E	15.00	4.80	376
82	1925	4	15	35.50N	29.00E	15.00	5.00	376
83	1925	4	15	35.50N	29.00E	15.00	5.20	376
84	1925	4	15	35.50N	29.00E	15.00	4.70	376
85	1925	4	15	35.50N	29.00E	15.00	4.60	376
86	1925	6	24	40.88N	30.39E	10.00	4.60	529
87	1925	7	8	37.40N	30.50E	15.00	4.90	238
88	1925	7	9	37.40N	30.50E	15.00	4.80	238
89	1925	7	9	37.40N	30.50E	15.00	4.70	238
90	1925	7	15	37.40N	30.50E	15.00	4.50	238
91	1925	8	5	38.10N	29.80E	0.00	5.00	328
92	1925	8	7	38.10N	29.80E	20.00	5.90	328
93	1925	8	7	38.10N	29.80E	15.00	4.50	328
94	1925	8	8	38.10N	29.80E	15.00	4.80	328
95	1925	8	9	38.10N	29.80E	15.00	4.80	328
96	1925	8	16	38.10N	29.80E	15.00	5.10	328
97	1925	9	1	37.56N	29.17E	130.00	5.40	354
98	1925	9	3	38.00N	29.00E	15.00	4.50	385
99	1925	9	14	39.00N	31.00E	0.00	4.90	321
100	1925	9	20	39.00N	31.00E	0.00	4.90	321

Earthquake Catalogues within the specified area

CATALOGUE OF EARTHQUAKES(3)
(DATA FROM 1901Y TO 1987Y)

No.	D A T E Year	Month	Day	Epicenter Latitude	Longitude	Depth (km)	Magunitude	Distance (km) from Site to Epicenter
101	1925	12	18	37.40N	30.40E	15.00	5.10	246
102	1926	1	13	38.64N	28.11E	50.00	5.80	486
103	1926	1	13	38.53N	28.19E	10.00	5.70	474
104	1926	3	1	37.03N	29.43E	50.00	6.10	319
105	1926	3	3	37.00N	29.40E	0.00	5.00	321
106	1926	3	17	37.00N	35.00E	0.00	5.50	187
107	1926	3	18	35.84N	29.50E	10.00	6.80	321
108	1926	3	18	35.88N	29.84E	80.00	5.40	291
109	1926	3	18	36.00N	29.00E	12.00	4.70	361
110	1926	3	19	35.80N	29.50E	0.00	5.20	323
111	1926	3	21	35.80N	29.50E	0.00	5.10	323
112	1926	3	23	35.80N	29.50E	0.00	5.30	323
113	1926	3	24	35.90N	28.97E	90.00	5.50	366
114	1926	3	28	35.80N	29.50E	0.00	4.80	323
115	1926	3	31	35.80N	29.50E	0.00	4.90	323
116	1926	4	1	35.80N	29.50E	0.00	5.00	323
117	1926	4	2	35.80N	29.50E	0.00	4.80	323
118	1926	4	22	35.80N	29.50E	0.00	5.00	323
119	1926	6	27	36.00N	28.00E	60.00	4.90	449
120	1926	12	16	40.13N	30.72E	10.00	5.70	442
121	1926	12	20	39.00N	31.00E	0.00	4.90	321
122	1927	2	7	39.00N	31.00E	15.00	5.20	321
123	1927	5	2	32.50N	31.00E	0.00	4.60	487
124	1927	6	5	36.19N	31.08E	10.00	5.50	174
125	1927	7	11	32.00N	35.50E	0.00	6.20	558
126	1927	12	12	34.50N	34.00E	0.00	5.40	248
127	1928	1	24	40.99N	30.86E	10.00	5.30	524
128	1928	2	22	32.10N	35.50E	0.00	5.20	548
129	1928	5	2	39.64N	29.14E	10.00	6.10	478
130	1928	5	6	39.80N	30.50E	12.00	5.00	419
131	1928	7	5	39.20N	34.80E	0.00	4.50	334
132	1928	8	23	36.50N	36.00E	0.00	4.80	271
133	1928	10	3	40.47N	33.42E	70.00	5.00	436
134	1928	10	4	40.22N	33.67E	10.00	5.70	411
135	1929	4	27	40.51N	31.43E	70.00	4.80	458
136	1929	5	1	34.00N	28.00E	15.00	5.20	533
137	1929	8	5	38.00N	29.50E	15.00	4.50	346
138	1929	5	16	36.50N	36.00E	0.00	4.50	271
139	1929	5	18	40.20N	37.90E	10.00	6.10	589
140	1929	5	19	40.20N	37.90E	0.00	4.50	589
141	1929	6	28	40.20N	37.90E	0.00	4.50	589
142	1929	8	4	36.50N	31.00E	15.00	4.90	176
143	1930	4	9	39.70N	34.00E	0.00	5.00	360
144	1930	5	9	39.55N	39.26E	10.00	5.40	642
145	1930	6	5	35.80N	30.30E	15.00	4.90	254
146	1930	7	25	35.00N	32.00E	0.00	4.90	195
147	1930	9	11	37.39N	31.18E	80.00	5.90	183
148	1930	11	16	34.10N	32.20E	0.00	5.10	283
149	1931	1	12	38.47N	31.80E	20.00	5.00	235
150	1931	1	12	38.50N	31.90E	0.00	5.00	235

Earthquake Catalogues within the specified area

CATALOGUE OF EARTHQUAKES (4)
(DATA FROM 1901Y TO 1987Y)

No.	D Year	A Month	T Day	Epicenter Latitude	Epicenter Longitude	Depth (km)	Magunitude	Distance (km) from Site to Epicenter
151	1932	5	14	35.88N	28.65E	78.00	4.70	395
152	1932	10	15	40.90N	30.60E	15.00	4.50	523
153	1932	12	26	36.90N	34.73E	60.00	5.20	161
154	1933	6	15	34.20N	29.50E	15.00	4.50	410
155	1933	6	28	39.30N	33.20E	0.00	4.70	305
156	1933	7	19	38.19N	29.79E	40.00	5.70	334
157	1933	8	17	37.36N	28.82E	60.00	4.50	379
158	1933	9	25	37.00N	35.50E	0.00	5.00	231
159	1934	2	25	40.31N	36.56E	40.00	4.50	520
160	1934	6	19	37.86N	31.13E	50.00	5.30	217
161	1935	7	12	40.60N	33.60E	0.00	4.80	452
162	1936	1	20	35.80N	32.11E	140.00	5.00	115
163	1936	1	23	35.80N	31.15E	70.00	4.70	184
164	1936	6	14	36.64N	35.85E	70.00	5.50	257
165	1936	8	2	37.88N	29.70E	70.00	4.80	324
166	1936	8	2	38.11N	29.65E	10.00	4.80	340
167	1936	8	3	36.50N	31.00E	0.00	4.70	176
168	1936	8	10	36.61N	31.03E	100.00	4.70	173
169	1936	8	12	37.44N	29.44E	130.00	5.00	328
170	1936	9	22	40.98N	33.26E	60.00	4.80	491
171	1937	4	28	35.91N	30.94E	100.00	5.00	196
172	1937	5	29	36.29N	31.05E	100.00	5.00	174
173	1937	6	26	34.70N	32.70E	0.00	5.00	209
174	1938	4	19	39.44N	33.79E	10.00	6.60	327
175	1938	4	19	39.65N	33.87E	30.00	5.00	352
176	1938	4	27	39.89N	34.10E	10.00	4.60	382
177	1938	5	14	39.74N	33.55E	10.00	4.80	356
178	1938	5	14	39.40N	33.80E	0.00	4.70	323
179	1938	5	28	39.40N	33.81E	30.00	4.90	323
180	1938	5	31	40.90N	33.73E	10.00	5.10	486
181	1938	5	31	41.00N	33.50E	0.00	4.90	495
182	1938	7	21	39.56N	33.68E	10.00	5.00	339
183	1938	11	25	39.00N	38.00E	0.00	4.80	518
184	1938	12	16	39.52N	33.91E	10.00	4.80	338
185	1939	3	13	36.00N	29.00E	15.00	5.00	361
186	1939	7	24	37.20N	28.30E	15.00	4.80	421
187	1939	7	25	39.75N	29.52E	50.00	5.20	465
188	1939	7	31	39.80N	29.60E	10.00	4.80	464
189	1939	8	2	39.75N	29.48E	50.00	5.30	467
190	1939	8	3	39.75N	29.68E	50.00	5.50	456
191	1939	8	9	39.91N	29.81E	60.00	5.10	463
192	1939	9	15	39.76N	29.56E	20.00	5.70	463
193	1939	10	19	39.82N	29.50E	10.00	5.30	472
194	1939	12	27	40.80N	36.80E	0.00	4.50	576
195	1939	12	27	40.83N	36.80E	10.00	4.90	579
196	1939	12	28	40.47N	37.00E	40.00	5.70	558
197	1940	2	1	41.00N	33.00E	0.00	4.90	493
198	1940	2	21	38.40N	35.30E	0.00	5.20	290
199	1940	4	13	40.04N	35.20E	30.00	5.60	432
200	1940	6	7	40.06N	37.82E	10.00	4.60	574

Earthquake Catalogues within the specified area

CATALOGUE OF EARTHQUAKES (5)
(DATA FROM 1901Y TO 1987Y)

No.	D A T E Year	Month	Day	Epicenter Latitude	Longitude	Depth (km)	Magunitude	Distance (km) from Site to Epicenter
201	1940	7	24	34.50N	34.50E	100.00	5.40	268
202	1940	7	30	39.64N	35.25E	50.00	6.20	396
203	1940	7	31	39.72N	35.53E	10.00	4.90	416
204	1940	8	16	35.90N	30.40E	80.00	5.50	242
205	1940	8	16	35.80N	30.50E	40.00	5.20	237
206	1940	8	19	40.13N	30.09E	40.00	4.50	469
207	1940	10	11	40.81N	33.30E	10.00	4.90	472
208	1941	1	20	35.00N	34.00E	100.00	6.50	198
209	1941	2	9	40.13N	28.27E	0.00	4.60	569
210	1941	4	20	37.35N	35.74E	100.00	4.60	261
211	1941	4	27	39.68N	35.31E	60.00	5.70	402
212	1941	5	23	37.07N	28.21E	40.00	6.00	427
213	1941	5	23	37.20N	28.40E	10.00	4.50	412
214	1941	5	23	37.13N	28.38E	40.00	5.30	413
215	1941	5	23	37.22N	28.35E	48.00	5.20	417
216	1941	9	21	37.50N	28.29E	70.00	5.30	428
217	1941	10	14	37.20N	28.40E	15.00	4.60	412
218	1941	12	13	37.13N	28.06E	30.00	6.50	441
219	1942	2	2	35.00N	28.00E	15.00	5.30	481
220	1942	10	28	39.27N	28.19E	10.00	5.40	515
221	1942	11	15	39.55N	28.58E	10.00	6.10	507
222	1942	11	21	40.82N	34.44E	80.00	5.50	490
223	1942	12	11	40.76N	34.83E	40.00	5.90	493
224	1942	12	20	40.87N	36.47E	10.00	7.00	566
225	1943	4	9	34.55N	28.01E	8.00	5.00	501
226	1943	4	14	39.62N	29.64E	40.00	5.00	447
227	1943	6	20	40.85N	30.51E	10.00	6.60	521
228	1943	6	20	40.84N	30.73E	10.00	5.50	513
229	1943	9	6	40.21N	31.35E	10.00	4.90	429
230	1943	11	15	36.81N	28.84E	83.00	5.20	369
231	1943	11	20	36.55N	28.36E	35.00	5.50	411
232	1943	11	27	41.00N	33.70E	0.00	4.70	497
233	1943	11	27	41.00N	33.70E	0.00	4.80	497
234	1943	11	27	40.78N	33.93E	40.00	4.90	476
235	1944	1	2	41.00N	33.70E	0.00	5.00	497
236	1944	2	1	41.41N	32.69E	10.00	5.00	539
237	1944	2	2	40.74N	31.44E	40.00	5.10	482
238	1944	2	10	41.00N	32.30E	10.00	5.30	496
239	1944	4	5	40.84N	31.12E	10.00	5.50	501
240	1944	6	25	38.79N	29.31E	40.00	6.00	406
241	1944	6	25	38.97N	29.87E	40.00	5.50	381
242	1944	10	18	40.89N	33.47E	10.00	5.20	482
243	1945	2	9	40.50N	31.20E	0.00	4.90	463
244	1945	3	20	37.11N	35.70E	60.00	6.00	251
245	1945	9	2	34.43N	28.61E	62.00	6.40	460
246	1945	12	21	37.90N	29.00E	4.00	4.70	381
247	1946	2	21	38.24N	31.79E	60.00	5.50	213
248	1946	7	16	38.63N	31.15E	40.00	5.10	280
249	1947	12	9	36.52N	34.34E	10.00	5.60	123
250	1947	12	19	40.71N	32.82E	10.00	4.90	461

Earthquake Catalogues within the specified area

CATALOGUE OF EARTHQUAKES(6)
(DATA FROM 1901Y TO 1987Y)

No.	DATE Year	Month	Day	Epicenter Latitude	Longitude	Depth (km)	Magunitude	Distance (km) from Site to Epicenter
251	1948	1	13	38.10N	28.80E	30.00	4.80	406
252	1948	4	30	36.05N	31.14E	80.00	5.80	173
253	1948	8	10	38.48N	28.94E	80.00	4.90	414
254	1948	11	13	40.23N	29.02E	60.00	5.60	533
255	1949	2	5	39.89N	29.35E	40.00	5.00	486
256	1949	5	13	40.94N	32.71E	20.00	5.10	487
257	1949	6	17	34.40N	28.50E	80.00	5.40	471
258	1949	11	28	40.98N	30.74E	10.00	4.70	527
259	1950	1	14	36.50N	35.80E	0.00	4.50	253
260	1950	6	4	36.53N	28.84E	30.00	4.80	369
261	1950	11	28	39.73N	28.05E	40.00	5.10	555
262	1951	1	30	32.40N	33.40E	0.00	5.70	465
263	1951	4	8	36.58N	35.85E	50.00	5.80	257
264	1951	7	12	36.60N	36.30E	0.00	4.80	298
265	1951	8	5	34.20N	36.00E	0.00	4.70	381
266	1951	8	8	35.95N	31.15E	40.00	4.60	177
267	1951	8	13	40.88N	32.87E	10.00	6.90	479
268	1951	8	14	41.08N	33.18E	40.00	4.80	502
269	1951	9	15	40.15N	28.02E	40.00	5.00	587
270	1951	11	5	36.00N	29.00E	0.00	5.20	361
271	1952	3	19	39.60N	28.64E	40.00	5.40	507
272	1952	9	23	36.90N	29.58E	10.00	4.80	304
273	1952	10	15	34.70N	33.10E	0.00	4.50	208
274	1952	10	22	37.25N	35.65E	70.00	5.60	250
275	1953	1	12	36.00N	28.00E	0.00	4.80	449
276	1953	2	1	33.50N	32.00E	0.00	5.00	352
277	1953	3	24	37.02N	37.00E	10.00	5.00	363
278	1953	6	3	40.28N	28.53E	20.00	5.30	565
279	1953	6	9	39.34N	28.21E	20.00	4.60	518
280	1953	6	19	35.80N	28.20E	15.00	4.50	436
281	1953	7	22	39.24N	28.43E	10.00	5.20	496
282	1953	9	4	35.00N	28.20E	15.00	4.50	464
283	1953	9	5	35.50N	28.00E	15.00	5.00	462
284	1953	9	10	34.80N	32.50E	0.00	6.30	201
285	1954	4	8	37.27N	29.53E	10.00	4.80	315
286	1954	8	25	37.29N	29.96E	40.00	4.90	279
287	1954	10	28	32.40N	31.40E	0.00	4.80	485
288	1955	9	12	32.20N	29.60E	0.00	6.10	575
289	1956	1	6	41.00N	30.20E	10.00	4.90	548
290	1956	2	20	39.89N	30.49E	40.00	6.40	428
291	1956	2	23	39.76N	30.17E	60.00	5.20	431
292	1956	3	16	33.80N	35.60E	0.00	6.00	390
293	1956	3	16	33.80N	35.60E	0.00	5.70	390
294	1956	5	5	36.99N	28.63E	40.00	4.70	389
295	1956	6	22	38.48N	31.94E	40.00	4.60	231
296	1956	7	14	40.32N	30.90E	40.00	4.60	454
297	1956	7	16	35.72N	36.01E	100.00	4.50	289
298	1956	12	27	35.55N	28.03E	10.00	4.90	458
299	1957	2	5	36.37N	28.88E	60.00	5.20	366
300	1957	4	24	36.43N	28.63E	80.00	6.80	388

Earthquake Catalogues within the specified area

CATALOGUE OF EARTHQUAKES(7)
(DATA FROM 1901Y TO 1987Y)

No.	D A T E Year	Month	Day	Epicenter Latitude	Longitude	Depth (km)	Magunitude	Distance (km) from Site to Epicenter
301	1957	4	25	36.42N	28.68E	80.00	7.10	383
302	1957	4	25	36.12N	28.60E	10.00	5.00	394
303	1957	4	26	36.22N	28.87E	50.00	5.90	369
304	1957	4	26	36.41N	28.80E	10.00	4.70	373
305	1957	5	26	40.67N	31.00E	10.00	7.10	487
306	1957	5	26	40.60N	30.74E	40.00	5.40	488
307	1957	5	26	40.76N	30.81E	10.00	5.90	502
308	1957	5	27	40.84N	31.17E	80.00	4.70	500
309	1957	5	27	40.73N	30.95E	50.00	5.80	495
310	1957	5	28	40.58N	30.53E	50.00	4.80	494
311	1957	5	28	40.57N	31.02E	40.00	4.70	476
312	1957	5	29	40.72N	31.04E	20.00	4.70	491
313	1957	5	29	40.83N	30.77E	20.00	4.90	511
314	1957	6	1	40.75N	30.86E	50.00	5.00	500
315	1957	6	1	40.68N	30.84E	40.00	4.80	493
316	1957	6	2	40.71N	30.78E	10.00	4.80	498
317	1957	7	14	35.79N	28.56E	10.00	4.90	405
318	1957	8	14	35.50N	28.00E	15.00	5.00	462
319	1957	9	21	40.75N	34.02E	40.00	5.10	474
320	1957	10	11	39.32N	28.19E	10.00	4.90	518
321	1957	10	24	40.06N	29.75E	10.00	4.70	479
322	1957	11	3	32.50N	35.90E	0.00	5.50	526
323	1957	12	26	40.83N	29.27E	10.00	5.20	572
324	1958	4	22	36.58N	30.46E	80.00	4.80	224
325	1958	5	21	40.65N	33.36E	10.00	4.60	455
326	1958	9	3	38.27N	28.19E	10.00	4.60	462
327	1958	11	6	37.00N	31.35E	40.00	4.80	152
328	1958	12	9	36.56N	28.16E	50.00	4.50	429
329	1958	12	19	37.81N	29.52E	40.00	4.50	335
330	1959	1	3	35.26N	29.04E	80.00	4.90	382
331	1959	1	6	36.85N	29.16E	20.00	4.50	341
332	1959	1	6	36.66N	29.11E	30.00	4.80	344
333	1959	1	7	36.71N	29.21E	40.00	4.80	336
334	1959	1	11	36.64N	29.12E	50.00	4.70	343
335	1959	1	20	36.70N	28.70E	0.00	4.80	381
336	1959	1	26	36.78N	29.02E	47.00	5.00	353
337	1959	1	26	36.70N	29.00E	0.00	4.50	354
338	1959	2	15	34.58N	31.95E	80.00	5.30	239
339	1959	4	2	40.50N	29.41E	20.00	4.60	535
340	1959	4	25	36.94N	28.58E	30.00	5.90	393
341	1959	4	25	36.92N	28.60E	40.00	5.30	391
342	1959	6	9	36.81N	29.08E	20.00	4.70	348
343	1959	6	13	34.78N	32.51E	60.00	5.70	203
344	1959	9	28	35.74N	30.08E	100.00	5.10	275
345	1959	12	8	36.91N	29.07E	70.00	5.00	349
346	1960	1	9	37.07N	28.90E	49.00	4.90	366
347	1960	1	26	37.00N	28.93E	72.00	5.20	363
348	1960	1	26	36.89N	28.61E	30.00	4.60	390
349	1960	5	19	36.00N	34.00E	0.00	4.50	112
350	1960	6	19	38.87N	37.75E	70.00	4.50	492

Earthquake Catalogues within the specified area

CATALOGUE OF EARTHQUAKES (8)
(DATA FROM 1901Y TO 1987Y)

No.	D A T E Year	Month	Day	Epicenter Latitude	Longitude	Depth (km)	Magunitude	Distance (km) from Site to Epicenter
351	1960	7	26	40.56N	37.25E	40.00	4.60	579
352	1960	8	31	39.09N	35.98E	70.00	4.70	385
353	1960	9	16	35.58N	28.49E	40.00	5.20	417
354	1960	11	28	36.11N	31.09E	80.00	4.80	176
355	1960	12	1	38.36N	30.52E	50.00	4.80	294
356	1961	3	28	39.82N	30.19E	10.00	5.00	435
357	1961	5	23	36.70N	28.49E	70.00	6.30	400
358	1961	6	1	37.65N	36.76E	40.00	5.00	357
359	1961	6	21	37.89N	28.77E	60.00	5.00	399
360	1961	9	10	37.02N	36.11E	100.00	4.70	284
361	1961	9	15	34.98N	33.83E	33.00	6.00	193
362	1962	4	1	40.80N	36.10E	10.00	4.70	543
363	1962	8	7	35.73N	30.34E	100.00	4.50	254
364	1962	8	18	36.97N	32.52E	140.00	4.70	60
365	1962	9	14	39.57N	28.17E	40.00	4.50	536
366	1963	3	11	37.96N	29.14E	40.00	5.50	372
367	1963	7	26	36.84N	28.76E	80.00	5.10	376
368	1963	9	12	34.77N	32.29E	49.00	5.00	209
369	1963	9	18	40.77N	29.12E	40.00	6.30	574
370	1963	9	24	40.84N	28.90E	10.00	4.80	591
371	1963	9	29	36.44N	29.00E	60.00	4.80	355
372	1963	11	12	35.48N	29.61E	83.00	5.10	325
373	1963	11	22	37.07N	29.68E	60.00	4.70	298
374	1964	1	30	37.41N	29.89E	59.00	5.70	289
375	1964	3	31	36.43N	28.78E	57.00	4.70	374
376	1964	6	12	37.34N	29.93E	5.00	4.50	283
377	1964	6	19	40.74N	32.83E	33.00	4.50	464
378	1964	6	28	34.77N	32.35E	63.00	4.80	207
379	1964	7	16	36.14N	30.78E	72.00	4.60	202
380	1964	7	28	34.64N	32.25E	52.00	4.50	224
381	1964	8	25	35.50N	28.76E	28.00	4.50	396
382	1964	8	25	35.75N	28.84E	51.00	4.80	381
383	1964	8	25	35.35N	28.58E	12.00	4.60	417
384	1964	8	25	35.55N	28.82E	35.00	4.80	389
385	1964	8	27	35.56N	28.84E	38.00	5.40	387
386	1964	8	29	35.29N	28.72E	35.00	4.70	408
387	1964	9	18	35.69N	29.07E	40.00	5.30	363
388	1964	9	23	34.20N	32.70E	67.00	4.80	264
389	1964	10	6	40.24N	28.16E	23.00	5.10	585
390	1964	10	6	40.30N	28.23E	34.00	7.00	585
391	1964	10	20	40.00N	28.60E	0.00	4.80	539
392	1964	11	17	36.81N	35.33E	4.00	4.60	212
393	1964	12	15	36.46N	34.80E	41.00	4.50	164
394	1964	12	15	40.02N	28.79E	26.00	4.60	529
395	1965	1	20	40.50N	34.00E	33.00	4.50	446
396	1965	1	25	34.56N	32.84E	20.00	4.80	223
397	1965	3	2	38.47N	28.33E	42.00	5.60	460
398	1965	3	3	38.27N	28.47E	42.00	4.50	440
399	1965	3	17	34.64N	32.30E	52.00	4.60	223
400	1965	3	26	36.82N	30.94E	111.00	5.20	183

Earthquake Catalogues within the specified area

CATALOGUE OF EARTHQUAKES(9)
(DATA FROM 1901Y TO 1987Y)

No.	DATE Year	Month	Day	Epicenter Latitude	Longitude	Depth (km)	Magunitude	Distance (km) from Site to Epicenter
401	1965	4	19	34.56N	28.36E	33.00	4.50	473
402	1965	6	13	37.85N	29.32E	33.00	5.70	353
403	1965	6	17	37.77N	29.36E	37.00	4.50	346
404	1965	7	12	37.62N	29.35E	50.00	4.50	341
405	1965	11	25	37.24N	36.22E	50.00	4.50	299
406	1965	11	27	35.52N	29.25E	37.00	4.50	354
407	1965	12	2	37.61N	29.32E	38.00	4.60	344
408	1966	1	22	37.65N	29.95E	32.00	4.80	293
409	1966	2	8	36.23N	28.11E	79.00	4.60	436
410	1966	4	8	35.81N	30.99E	50.00	4.50	196
411	1966	5	9	37.05N	30.98E	132.00	5.00	185
412	1966	6	26	36.84N	35.92E	58.00	4.80	265
413	1966	9	25	37.77N	29.97E	44.00	5.20	297
414	1966	11	3	38.97N	31.10E	9.00	4.60	313
415	1966	12	7	40.10N	35.40E	78.00	4.70	446
416	1966	12	25	35.18N	28.20E	61.00	4.50	456
417	1966	12	29	36.10N	30.70E	74.00	4.50	210
418	1967	4	7	37.43N	36.17E	38.00	4.60	300
419	1967	4	7	37.36N	36.24E	32.00	4.80	304
420	1967	4	17	34.50N	32.84E	41.00	4.60	230
421	1967	5	22	36.59N	29.35E	54.00	4.60	323
422	1967	5	30	34.17N	28.67E	35.00	4.50	472
423	1967	6	1	36.81N	29.26E	43.00	4.90	332
424	1967	6	13	39.03N	31.14E	2.00	4.60	317
425	1967	6	15	34.09N	32.43E	52.00	4.70	280
426	1967	6	18	36.78N	29.32E	35.00	4.80	326
427	1967	7	19	38.10N	28.87E	41.00	4.90	400
428	1967	7	22	40.67N	30.69E	33.00	6.80	497
429	1967	7	22	40.70N	30.80E	6.00	4.60	496
430	1967	7	22	40.73N	30.53E	0.00	4.80	509
431	1967	7	22	40.66N	30.62E	26.00	5.10	498
432	1967	7	22	40.72N	30.51E	35.00	5.00	508
433	1967	7	22	41.07N	30.59E	59.00	4.70	541
434	1967	7	22	41.00N	30.45E	49.00	4.70	539
435	1967	7	23	40.61N	30.35E	21.00	4.50	504
436	1967	7	23	40.63N	30.36E	33.00	4.70	505
437	1967	7	25	37.90N	28.70E	101.00	4.50	406
438	1967	7	30	40.71N	30.58E	23.00	4.60	505
439	1967	7	30	40.72N	30.52E	18.00	5.60	508
440	1967	7	30	40.75N	30.46E	27.00	4.50	513
441	1967	8	1	40.72N	30.52E	26.00	4.60	508
442	1967	8	9	36.98N	28.40E	64.00	4.50	409
443	1967	8	14	40.74N	30.37E	25.00	4.90	516
444	1967	8	26	37.59N	30.44E	49.00	4.50	251
445	1967	9	5	36.72N	29.33E	24.00	4.60	325
446	1967	10	26	37.22N	29.05E	46.00	5.10	356
447	1967	11	13	37.78N	28.83E	34.00	4.50	390
448	1968	3	18	40.83N	30.53E	39.00	4.50	519
449	1968	3	26	34.08N	35.47E	37.00	4.80	358
450	1968	3	28	40.50N	31.34E	6.00	4.50	459

Earthquake Catalogues within the specified area

CATALOGUE OF EARTHQUAKES (10)
(DATA FROM 1901Y TO 1987Y)

No.	D A T E Year	Month	Day	Epicenter Latitude	Longitude	Depth (km)	Magunitude	Distance (km) from Site to Epicenter
451	1968	7	13	35.56N	28.05E	0.00	4.50	456
452	1968	7	31	35.54N	28.00E	49.00	4.70	461
453	1968	9	17	35.34N	31.24E	24.00	4.50	207
454	1968	9	19	35.17N	31.10E	23.00	4.50	229
455	1968	9	26	38.76N	32.60E	40.00	4.50	246
456	1968	10	6	38.78N	32.59E	37.00	4.80	248
457	1968	10	10	36.50N	29.20E	0.00	4.70	337
458	1968	11	3	38.81N	29.11E	23.00	4.80	421
459	1968	11	6	35.13N	32.73E	65.00	4.80	161
460	1969	1	14	36.11N	29.19E	22.00	6.20	342
461	1969	3	4	36.98N	31.04E	109.00	5.20	178
462	1969	3	22	39.10N	28.67E	28.00	4.70	471
463	1969	3	23	39.14N	28.48E	9.00	5.90	487
464	1969	3	24	39.11N	28.51E	30.00	5.00	483
465	1969	3	24	39.15N	28.60E	4.00	4.50	479
466	1969	3	24	39.02N	28.41E	43.00	4.70	484
467	1969	3	24	39.17N	28.70E	37.00	4.60	473
468	1969	3	24	39.08N	28.65E	20.00	4.50	471
469	1969	3	25	39.06N	28.41E	28.00	4.90	487
470	1969	3	25	39.25N	28.44E	37.00	6.00	496
471	1969	3	25	38.78N	28.51E	40.00	4.80	463
472	1969	3	25	39.17N	28.49E	34.00	4.80	488
473	1969	3	25	39.08N	28.44E	42.00	4.70	486
474	1969	3	26	39.03N	28.27E	37.00	4.60	495
475	1969	3	27	39.12N	28.20E	51.00	4.50	505
476	1969	3	28	38.55N	28.46E	4.00	6.50	454
477	1969	3	28	38.09N	29.02E	29.00	4.50	388
478	1969	3	28	39.13N	28.45E	37.00	4.90	488
479	1969	4	24	36.35N	28.73E	53.00	4.70	380
480	1969	4	27	36.54N	28.21E	33.00	4.70	425
481	1969	4	30	39.12N	28.52E	8.00	5.20	482
482	1969	5	3	35.21N	28.03E	81.00	4.60	469
483	1969	5	13	39.03N	28.57E	35.00	4.60	473
484	1969	5	14	39.15N	28.49E	36.00	4.60	487
485	1969	7	11	35.32N	28.10E	40.00	4.50	459
486	1969	9	6	36.73N	28.35E	72.00	5.10	412
487	1969	9	22	36.57N	28.01E	86.00	4.70	443
488	1969	10	7	39.20N	28.40E	13.00	5.10	496
489	1969	10	7	39.16N	28.54E	49.00	4.50	484
490	1969	11	15	37.78N	29.91E	6.00	4.60	302
491	1969	12	21	36.66N	28.42E	69.00	4.60	405
492	1969	12	24	40.50N	28.40E	0.00	4.50	590
493	1970	2	1	34.49N	32.70E	17.00	4.60	232
494	1970	3	18	34.42N	32.49E	38.00	4.50	243
495	1970	3	28	39.21N	29.51E	18.00	7.20	422
496	1970	3	28	38.10N	29.20E	33.00	4.70	374
497	1970	3	28	39.13N	29.53E	42.00	4.50	415
498	1970	3	28	39.28N	29.46E	17.00	4.80	431
499	1970	3	28	39.15N	29.56E	31.00	5.20	414
500	1970	3	29	39.07N	29.76E	32.00	5.20	396

Earthquake Catalogues within the specified area

CATALOGUE OF EARTHQUAKES (11)
(DATA FROM 1901Y TO 1987Y)

No.	DATE Year	Month	Day	Epicenter Latitude	Longitude	Depth (km)	Magunitude	Distance (km) from Site to Epicenter
501	1970	3	29	39.29N	29.18E	38.00	4.60	449
502	1970	3	29	38.92N	29.70E	33.00	4.50	388
503	1970	3	29	39.12N	29.53E	22.00	4.60	414
504	1970	3	29	39.06N	29.74E	29.00	5.40	396
505	1970	3	29	38.74N	28.00E	47.00	4.50	499
506	1970	3	29	39.14N	29.42E	22.00	4.70	423
507	1970	3	30	39.09N	29.03E	23.00	4.50	445
508	1970	3	30	39.43N	29.40E	33.00	4.80	446
509	1970	3	30	39.34N	29.26E	16.00	5.30	448
510	1970	3	30	39.29N	29.24E	36.00	4.80	445
511	1970	3	30	39.09N	29.59E	30.00	5.20	408
512	1970	3	30	39.05N	29.62E	28.00	4.60	403
513	1970	3	30	39.30N	29.29E	33.00	4.60	443
514	1970	3	31	39.33N	29.41E	18.00	4.60	438
515	1970	3	31	39.03N	29.79E	35.00	4.80	391
516	1970	3	31	38.89N	29.73E	41.00	4.60	384
517	1970	4	1	39.32N	29.27E	35.00	4.80	446
518	1970	4	2	39.05N	29.72E	35.00	4.60	397
519	1970	4	7	39.32N	29.09E	33.00	4.50	457
520	1970	4	7	39.34N	29.32E	33.00	5.20	444
521	1970	4	9	39.11N	29.41E	34.00	4.70	421
522	1970	4	11	39.09N	29.76E	22.00	4.60	397
523	1970	4	13	39.32N	29.03E	15.00	4.50	461
524	1970	4	15	39.34N	29.30E	28.00	4.80	445
525	1970	4	16	39.02N	29.91E	31.00	5.40	383
526	1970	4	16	38.98N	29.95E	43.00	4.70	377
527	1970	4	19	39.03N	29.76E	18.00	5.80	393
528	1970	4	19	39.03N	29.80E	24.00	5.80	390
529	1970	4	20	38.98N	30.09E	35.00	4.50	369
530	1970	4	21	39.08N	29.90E	25.00	4.50	388
531	1970	4	22	39.02N	29.77E	37.00	5.00	391
532	1970	4	22	39.08N	29.43E	48.00	4.80	418
533	1970	4	23	38.94N	30.01E	32.00	4.90	370
534	1970	4	23	39.13N	28.65E	28.00	5.60	474
535	1970	4	24	39.01N	29.85E	32.00	4.80	386
536	1970	4	24	36.75N	28.66E	34.00	4.60	385
537	1970	4	27	38.94N	29.81E	37.00	4.60	383
538	1970	4	27	38.96N	29.58E	33.00	4.70	399
539	1970	4	27	39.06N	29.54E	11.00	4.70	409
540	1970	4	30	39.31N	29.31E	25.00	4.60	442
541	1970	4	30	39.32N	29.22E	24.00	4.70	449
542	1970	4	30	39.09N	29.59E	29.00	4.50	408
543	1970	5	8	38.93N	29.98E	20.00	4.50	371
544	1970	5	26	38.92N	29.44E	59.00	4.50	406
545	1970	5	28	38.95N	30.03E	34.00	4.60	370
546	1970	6	10	39.15N	29.46E	43.00	4.50	421
547	1970	6	20	38.85N	29.87E	47.00	4.50	372
548	1970	7	1	35.23N	31.29E	53.00	4.80	212
549	1970	7	2	38.87N	36.81E	19.00	4.90	424
550	1970	7	10	40.99N	35.91E	37.00	4.50	554

Earthquake Catalogues within the specified area

CATALOGUE OF EARTHQUAKES (12)
(DATA FROM 1901Y TO 1987Y)

No.	D A T E Year	Month	Day	Epicenter Latitude	Longitude	Depth (km)	Magunitude	Distance (km) from Site to Epicenter
551	1970	8	7	39.08N	30.01E	41.00	4.50	381
552	1970	9	9	34.59N	32.21E	49.00	4.70	230
553	1970	9	9	38.97N	29.52E	0.00	4.80	404
554	1970	9	14	39.24N	29.32E	37.00	4.60	437
555	1970	9	21	38.80N	30.00E	27.00	4.50	360
556	1970	9	28	37.09N	28.59E	24.00	4.50	394
557	1970	10	13	38.28N	36.98E	34.00	4.60	402
558	1970	11	11	35.99N	28.24E	35.00	5.10	428
559	1970	11	17	36.74N	29.55E	44.00	4.50	305
560	1970	12	17	39.27N	29.40E	26.00	4.50	434
561	1970	12	20	39.36N	29.24E	26.00	5.50	451
562	1970	12	28	37.06N	29.02E	7.00	4.50	356
563	1970	12	28	35.92N	28.21E	28.00	4.60	432
564	1970	12	29	36.03N	28.34E	26.00	4.60	419
565	1970	12	30	36.96N	28.94E	23.00	4.50	361
566	1971	1	31	37.04N	30.28E	31.00	4.60	245
567	1971	2	1	37.13N	30.28E	30.00	4.50	247
568	1971	2	7	36.06N	28.29E	25.00	4.50	423
569	1971	2	15	39.19N	29.36E	36.00	4.90	430
570	1971	2	20	37.82N	29.39E	47.00	4.50	346
571	1971	2	22	37.24N	30.30E	47.00	5.10	249
572	1971	2	24	37.05N	29.00E	12.00	4.50	357
573	1971	2	25	37.06N	29.09E	9.00	4.50	349
574	1971	2	26	37.49N	29.83E	34.00	4.60	297
575	1971	3	8	37.49N	29.84E	36.00	4.80	296
576	1971	4	10	38.83N	29.14E	20.00	4.60	420
577	1971	4	13	39.03N	29.80E	41.00	5.20	390
578	1971	4	16	33.64N	35.43E	8.00	4.50	395
579	1971	4	27	38.91N	29.06E	14.00	4.60	431
580	1971	5	6	39.04N	29.75E	34.00	4.70	394
581	1971	5	12	37.64N	29.72E	30.00	5.90	312
582	1971	5	12	37.51N	29.71E	29.00	5.20	307
583	1971	5	12	37.60N	29.68E	36.00	5.40	313
584	1971	5	12	37.58N	29.60E	33.00	5.60	319
585	1971	5	12	37.63N	30.10E	43.00	4.50	280
586	1971	5	12	37.60N	29.93E	35.00	4.60	293
587	1971	5	12	37.49N	29.70E	40.00	4.50	308
588	1971	5	12	37.56N	29.86E	8.00	4.70	297
589	1971	5	13	37.49N	29.78E	23.00	4.80	301
590	1971	5	13	37.56N	29.97E	35.00	4.60	288
591	1971	5	13	37.59N	30.06E	13.00	4.50	282
592	1971	5	13	37.51N	29.83E	0.00	4.50	297
593	1971	5	13	37.67N	29.99E	27.00	4.70	291
594	1971	5	13	37.55N	29.93E	33.00	4.60	291
595	1971	5	14	37.65N	29.96E	31.00	4.60	293
596	1971	5	14	37.47N	29.55E	8.00	4.60	319
597	1971	5	15	37.61N	29.96E	34.00	4.50	291
598	1971	5	15	37.54N	29.77E	28.00	4.50	304
599	1971	5	15	37.62N	29.88E	14.00	4.50	298
600	1971	5	15	37.64N	29.91E	29.00	4.60	296

Earthquake Catalogues within the specified area

CATALOGUE OF EARTHQUAKES (13)
(DATA FROM 1901Y TO 1987Y)

No.	D A T E Year	Month	Day	Epicenter Latitude	Longitude	Depth (km)	Magunitude	Distance (km) from Site to Epicenter
601	1971	5	16	37.54N	29.95E	18.00	4.70	289
602	1971	5	16	37.55N	29.86E	32.00	4.60	297
603	1971	5	16	37.55N	29.81E	3.00	4.80	301
604	1971	5	17	37.67N	29.87E	39.00	4.80	301
605	1971	5	18	37.48N	29.91E	33.00	4.50	290
606	1971	5	20	37.56N	30.00E	15.00	4.50	285
607	1971	5	20	37.58N	29.98E	23.00	4.80	288
608	1971	5	21	37.52N	29.65E	12.00	4.80	313
609	1971	5	23	37.61N	30.12E	6.00	4.50	278
610	1971	5	23	37.48N	29.95E	35.00	4.70	286
611	1971	5	24	37.48N	29.89E	2.00	4.50	291
612	1971	5	25	39.05N	29.71E	16.00	5.90	397
613	1971	5	25	38.89N	29.74E	33.00	4.60	384
614	1971	6	4	37.56N	29.82E	7.00	4.60	300
615	1971	6	8	37.48N	29.81E	21.00	4.80	298
616	1971	6	8	37.55N	29.79E	11.00	4.80	302
617	1971	6	10	39.02N	29.63E	33.00	5.10	400
618	1971	6	15	37.03N	29.04E	3.00	4.70	353
619	1971	6	19	37.16N	29.64E	34.00	4.70	303
620	1971	6	28	37.62N	29.87E	23.00	4.80	299
621	1971	6	29	37.51N	29.87E	29.00	4.70	294
622	1971	6	29	37.11N	36.85E	35.00	5.10	351
623	1971	6	29	37.33N	36.72E	12.00	4.50	344
624	1971	7	1	37.17N	36.91E	37.00	4.50	357
625	1971	7	11	37.16N	36.85E	19.00	5.30	352
626	1971	7	15	37.20N	36.80E	34.00	4.60	348
627	1971	8	7	38.87N	29.91E	20.00	4.60	371
628	1971	8	9	37.51N	29.71E	11.00	4.60	307
629	1971	8	17	37.09N	36.77E	35.00	5.10	343
630	1971	9	3	36.80N	28.80E	0.00	4.60	372
631	1971	9	5	37.24N	30.19E	24.00	4.50	258
632	1971	9	8	37.22N	30.12E	6.00	4.90	263
633	1971	9	9	37.34N	30.18E	49.00	5.30	262
634	1971	9	21	37.27N	30.17E	42.00	4.80	261
635	1971	9	28	37.21N	30.15E	32.00	4.70	260
636	1971	10	3	38.94N	29.92E	26.00	4.70	376
637	1971	10	5	38.93N	29.61E	30.00	4.50	395
638	1971	10	6	38.22N	30.14E	19.00	4.60	310
639	1971	10	16	36.63N	28.54E	61.00	4.80	395
640	1971	10	21	37.92N	30.28E	33.00	4.50	281
641	1971	11	6	39.02N	29.78E	16.00	5.10	391
642	1972	3	14	39.32N	29.47E	38.00	5.20	433
643	1972	5	28	38.96N	30.04E	29.00	4.80	370
644	1972	8	3	37.85N	32.81E	34.00	4.50	143
645	1972	10	4	39.14N	29.44E	34.00	4.60	421
646	1973	2	7	37.58N	29.76E	34.00	4.50	306
647	1973	2	19	40.28N	33.86E	22.00	4.70	420
648	1973	2	27	38.83N	29.87E	30.00	4.50	371
649	1973	4	27	38.65N	32.92E	29.00	4.60	232
650	1973	7	28	36.06N	31.39E	77.00	4.50	152

Earthquake Catalogues within the specified area

CATALOGUE OF EARTHQUAKES(14)
(DATA FROM 1901Y TO 1987Y)

No.	D A T E Year	Month	Day	Epicenter Latitude	Longitude	Depth (km)	Magunitude	Distance (km) from Site to Epicenter
651	1973	9	18	36.85N	30.36E	35.00	4.50	234
652	1973	10	10	34.34N	28.45E	63.00	4.60	478
653	1973	12	8	37.32N	29.75E	17.00	4.50	298
654	1974	2	5	37.33N	29.68E	5.00	4.50	304
655	1974	6	12	34.10N	37.28E	0.00	4.60	478
656	1974	7	9	36.57N	28.48E	49.00	4.90	401
657	1974	12	24	37.54N	29.91E	24.00	4.60	292
658	1975	1	1	36.67N	36.49E	35.00	4.80	315
659	1975	1	21	39.07N	30.67E	23.00	4.50	344
660	1975	1	28	34.54N	33.81E	35.00	4.70	238
661	1975	4	28	34.60N	28.52E	37.00	4.70	458
662	1975	4	30	36.19N	30.74E	61.00	5.90	204
663	1975	7	15	40.93N	36.08E	18.00	4.70	555
664	1975	7	30	39.45N	32.13E	2.00	4.70	329
665	1975	9	20	36.14N	30.73E	40.00	4.90	206
666	1975	10	26	40.08N	35.02E	24.00	4.60	430
667	1975	11	12	36.28N	28.15E	64.00	5.50	432
668	1976	5	28	39.26N	29.17E	8.00	4.60	448
669	1976	7	15	37.55N	35.90E	55.00	4.60	282
670	1976	11	23	34.55N	28.43E	41.00	4.60	468
671	1977	3	23	39.63N	28.65E	23.00	4.60	508
672	1977	4	11	36.91N	30.73E	90.00	4.70	203
673	1978	1	30	34.67N	33.84E	36.00	4.50	225
674	1978	7	4	39.45N	33.19E	23.00	4.50	321
675	1978	12	4	38.07N	37.43E	37.00	4.60	428
676	1978	12	6	40.50N	34.97E	17.00	4.60	471
677	1979	5	28	36.46N	31.72E	111.00	5.20	112
678	1979	7	18	39.66N	28.65E	7.00	4.80	510
679	1979	12	31	36.22N	31.49E	93.00	4.80	138
680	1980	11	29	40.15N	26.97E	0.00	4.90	657
681	1980	11	30	36.46N	31.23E	0.00	4.60	156
682	1981	4	26	36.55N	30.51E	0.00	5.10	219
683	1981	8	10	36.27N	29.82E	0.00	4.60	283
684	1981	11	11	36.62N	30.11E	0.00	4.60	255
685	1983	11	6	39.32N	29.16E	0.00	4.50	453
686	1984	1	23	36.73N	31.02E	0.00	4.50	175
687	1984	2	11	36.93N	30.27E	0.00	4.60	244
688	1984	4	20	36.00N	28.12E	0.00	4.70	439
689	1984	5	7	36.81N	31.23E	0.00	4.50	157
690	1984	9	13	35.87N	29.96E	0.00	4.60	281
691	1985	5	20	36.14N	28.81E	0.00	4.70	375
692	1986	10	11	37.90N	28.48E	0.00	4.90	424
693	1986	12	8	36.62N	31.76E	0.00	4.60	108
694	1987	6	13	36.97N	28.27E	0.00	4.50	421
695	1987	11	9	34.77N	32.82E	0.00	4.50	200

COORDINATION OF DAM SITE

Latitude : 36.567N
Longitude: 32.967E

SPECIFICATION OF EARTHQUAKE DATA
Name of Data File : g1.dat
Range of Year :
from 1901 to 1987
Area (within a circle)
Radius of circle : 500 km

Analysis Result by Kawasumi's Method

LIST OF EARTHQUAKES (1)
(DATA FROM 1901Y TO 1987Y)

No.	D Year	A Month	T Day	Epicenter Latitude	Epicenter Longitude	Depth (km)	Magunitude	Distance (km) from Site to Epicenter	Intensity felt at the Site
1	1911	4	30	36.00N	30.00E	180.00	6.10	273	0.2
2	1914	10	3	37.70N	30.40E	14.00	6.90	260	1.9
3	1918	9	29	35.20N	34.70E	0.00	6.50	218	1.5
4	1921	1	16	38.33N	32.79E	10.00	5.70	197	0.2
5	1922	8	29	37.37N	32.73E	30.00	4.90	92	0.1
6	1926	3	18	35.84N	29.50E	10.00	6.80	321	1.2
7	1927	6	5	36.19N	31.08E	10.00	5.50	174	0.1
8	1930	9	11	37.39N	31.18E	80.00	5.90	183	0.7
9	1938	4	19	39.44N	33.79E	10.00	6.60	327	0.7
10	1941	1	20	35.00N	34.00E	100.00	6.50	198	1.8
11	1945	3	20	37.11N	35.70E	60.00	6.00	251	0.2
12	1947	12	9	36.52N	34.34E	10.00	5.60	123	1.0
13	1948	4	30	36.05N	31.14E	80.00	5.80	173	0.7
14	1951	8	13	40.88N	32.87E	10.00	6.90	479	0.3
15	1953	9	10	34.80N	32.50E	0.00	6.30	201	1.3
16	1957	4	24	36.43N	28.63E	80.00	6.80	388	0.7
17	1957	4	25	36.42N	28.68E	80.00	7.10	383	1.3
18	1957	5	26	40.67N	31.00E	10.00	7.10	487	0.6
19	1959	6	13	34.78N	32.51E	60.00	5.70	203	0.1
20	1961	9	15	34.98N	33.83E	33.00	6.00	193	0.8
21	1970	3	28	39.21N	29.51E	18.00	7.20	422	1.2
22	1975	4	30	36.19N	30.74E	61.00	5.90	204	0.5
23	1979	5	28	36.46N	31.72E	111.00	5.20	112	0.5

Earthquake Intensity and Frequancy

Intensity (Ij)	Frequancy in 87 years	Frequancy in 100 years	Cumulative Number for 100 years
0 (0.0 - 0.5)	9	10.34	26.43
1 (0.6 - 1.5)	12	13.79	16.09
2 (1.6 - 2.5)	2	2.30	2.30
3 (2.6 - 3.5)	0	0.00	0.00
4 (3.6 - 4.5)	0	0.00	0.00
5 (4.6 - 5.5)	0	0.00	0.00
6 (5.6 - 6.5)	0	0.00	0.00
7 (6.6 - 7.5)	0	0.00	0.00

Non-linear Regression Analysis by Least Square Method

LOG(Y) = 1.527 - 0.530 * X

Coeeficient of Correlation

RR = 0.946

Expected Maximum Intensity for 100 Years

= 2.88

Maximum Acceleration in a Return Period of 100 years

= 12 gal
= 0.01 g

Analysis Result by Least Square Method (1)

Relation between Magnitude and Number of Events (1)

Magunitude (dM=0.1)	Event Nos. (n)	M x n
4.50	113	508.5
4.60	89	409.4
4.70	65	305.5
4.80	78	374.4
4.90	39	191.1
5.00	46	230.0
5.10	26	132.6
5.20	35	182.0
5.30	19	100.7
5.40	17	91.8
5.50	16	88.0
5.60	7	39.2
5.70	17	96.9
5.80	8	46.4
5.90	11	64.9
6.00	6	36.0
6.10	3	18.3
6.20	2	12.4
6.30	2	12.6
6.40	2	12.8
6.50	4	26.0
6.60	1	6.6
6.70	0	0.0
6.80	3	20.4
6.90	2	13.8
7.00	0	0.0
7.10	2	14.2
7.20	1	7.2
Total	614	3041.7

Analysis Result by Least Square Method (2)

Log(N) = a - b M = 5.362 - 0.759 M

R = 0.954

a' = a - Log(b Ln(10)) = 5.120

a1 = a - Log(T) = 3.422

a1' = a' - Log(T) = 3.180

T = 87

Analysis Result by Least Square Method (3)

1) Seismic Activity expected in the future

- at the minimum value

N(M, 4.5) = 10 ^ (a1' - b M) = 0.581

Q(M, 4.5) = 1 / 0.581 = 1.720 years

- at the maximum value

N(M, 7.2) = 10 ^ (a1' - b M) = 0.005

Q(M, 7.2) = 1 / 0.005 = 192.654 years

2) Seismic Risk

- Calculation formula

Risk = 1 - e ^ (- N(M) T)
N(M) = 10 ^ (a1' - b M)
T = time period chosen

- Calculation Result

Return Period (Years)	Risk (%) M= 4.5	M= 7.2
5	94.5	2.6
10	99.7	5.1
25	100.0	12.2
50	100.0	22.9
75	100.0	32.2
100	100.0	40.5

Analysis Result by Probability Method (1)

Relation between Magnitude and Number of Events

Magunitude (dM=0.5)	Mean Value of Mag.(xi)	Event Nos. (ni)	yi = Log(ni)
4.5 - 4.9	4.7	384	2.584
5.0 - 5.4	5.2	143	2.155
5.5 - 5.9	5.7	59	1.771
6.0 - 6.4	6.2	15	1.176
6.5 - 6.9	6.7	10	1.000
7.0 - 7.4	7.2	3	0.477
Total (6 range)	35.7	614	9.164

Xave. = 35.7 / 6 = 5.950
Yave. = 9.164 / 6 = 1.527

Analysis Result by Probability Method (2)

b = Log(e) / (Mave. - Ms) = 0.862

Mave. = (M n)total / (n)total = 3041.7 / 614 = 4.954
Ms = (Ms)min. - dM/2 = 4.700 - 0.5/2= 4.450

a = Log(N(M)) + Log(b Ln(10)) + M b = 6.953

a' = a - Log(b Ln(10)) = 6.655

a1 = a - Log(T) = 5.013

a1' = a' - Log(T) = 4.716

T = 87

Analysis Result by Probability Method (3)

1) Seismic Activity expected in the future

- at the minimum value

N(M, 4.5) = 10 ^ (a1' - b M) = 6.878

Q(M, 4.5) = 1 / 6.878 = 0.145 years

- at the maximum value

N(M, 7.5) = 10 ^ (a1' - b M) = 0.018

Q(M, 7.5) = 1 / 0.018 = 55.989 years

2) Seismic Risk

- Calculation formula

Risk = 1 - e ^ (- N(M) T)
N(M) = 10 ^ (a1' - b M)
T = time period chosen

- Calculation Result

Return Period (Years)	Risk (%) M= 4.5	M= 7.5
5	100.0	8.5
10	100.0	16.4
25	100.0	36.0
50	100.0	59.1
75	100.0	73.8
100	100.0	83.2

ANNEX - B

CONSTRUCTION MATERIALS

ANNEX-B CONSTRUCTION MATERIALS

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TEXT

CHAPTER 1. INTRODUCTION

The field investigation and laboratory tests were carried out to identify locations, engineering properties and available quantity of the construction materials, which would be required for the Project.

The investigations were carried out by EİE for the project definition from 1984. And then, the additional investigations were performed jointly by EİE and the JICA study team from 1989 to 1990 for the feasibility study of the Project. All the investigation results are compiled in this report, and the detailed results are listed in the following reports prepared by EİE.

(1) ERMENEK BARAJ GEÇİRİMSİZ MALZEME DENEY RAPORU
Yayin: 86-76, December 1986

(2) ERMENEK BARAJ GEÇİRİMSİZ MALZEME SAHALARI DENEY SONUÇLARI II
Yayin: 88-22, April 1988

(3) ERMENEK PROJECT IMPERVIOUS MATERIAL TEST RESULTS
Yayin: 90-12, February 1990

(4) ERMENEK PROJECT ROCK MECHANICS TEST RESULTS
Yayin: 90-11, April 1990

CHAPTER 2. SITE INVESTIGATION AND LABORATORY TEST

2.1 Test Pit Investigation

28 test pits in pre-F/S stage and 16 test pits in F/S stage were excavated in order to take samples for laboratory tests. The depth and numbers of sampling are listed in Table B1, and the location of each test pit is shown in Plate G27. The geological condition of each test pit is summarized in the Attachment B1.

2.2 Laboratory Test

The test samples were taken from the test pits and boring cores. The methods of test are shown in Table B3. The test items and quantity are summarized in Table B2. The test results are summarized in Tables B4 to B8, and Figs. B1 to B7, and the details are shown in the EIE Reports mentioned in Chapter 1.

2.3 Core Boring Investigation

Two boreholes, SK-311 and 312, were drilled in the proposed quarry site as follows.

Hole No.	Depth (m)	EL. (m)	Location Lat.	Long.
SK-311	59.0	789.27	4,049,783.04	496,566.96
SK-312	50.0	864.52	4,049,521.46	496,600.14
Total	109.0			

The locations of boreholes are shown in Plates G27 and G28, and the boring logs are shown in Attachment B2.

CHAPTER 3. INVESTIGATION RESULTS

3.1 Impervious Core Materials

3.1.1 Material sources

As illustrated in Fig. B1, potential borrow areas of the core materials investigated are Aa, Ab, Fa, Fb, C, D, B and I along the Ermenek main stream, and Ea, Eb and Ec along the Zeyve river.

Geological conditions of test pits in these borrow areas are shown in Attachment B1.

3.1.2 Material properties

Material properties required for the core materials are as follows.

(1) To be practically impervious. It is preferable to be less than 1×10^{-6} cm/s in the laboratory permeability test although it will be specified to be less than 1×10^{-5} cm/s.

(2) To contain neither soluble matters nor organic matters.

(3) To have good workability in the embankment construction. The natural moisture content is preferable to be as close as to the optimum for the regular core, at most to be within 5 % drier and 3 % wetter than the optimum in terms of practicable range of moisture control. That for the rock contact core be within 0 % and 4 % above optimum.

(4) To have relatively high shear strength which may contribute to ensure the stability of the dam.

(5) To have less compressibility which may prevent the core from cracking caused by settlement.

(6) To have high plasticity, preferably of more than 10 % in plasticity index, which may bring high resistivity against erosion by seepage water.

Results of the laboratory tests are summarized in Table B4 and illustrated in Figs. B1 to 5. Based on the above material requirements, materials obtainable in the borrow areas are assessed as below.

(1) Borrow area Aa

The grading of materials in this borrow area is generally fine, that is, - # 200 fraction is 74 % on average. The plasticity index is 8.2 % on average which are slightly lower than that preferred, and is classified as ML in the Unified Soil Classification System (USC, refer to Table B9).

The average coefficient of the permeability in the laboratory test shows approximately 2×10^{-6} cm/s. This coefficient is relatively higher than those in the other borrow areas, which are slightly higher than that preferable.

The natural moisture contents are slightly higher than the optimum by 0.4 to 3.4 %, 1.9 % on average, which are in the acceptable range.

Hence these materials are considered less preferable.

(2) Borrow area Ab

The grading test results show that the materials in this area are sandy and the plasticity is non-plastic, which are classified as SP in USC.

The average of the coefficient of permeability is 1.3 x 10^{-5} cm/s, which are too high to accept for the core materials.

Hence these are considered to be not suitable for the core materials.

(3) Borrow area Fa

The grading of the materials is generally fine having 77 % of - # 200 fraction. The average plasticity is 13 %, which are fairly high and classified as CL in the USC.

The average permeability is 2 x 10^{-7} cm/s, which are low enough for the core materials.

The natural moisture content ranges from 1 to 5 %, and 2.8 % on average above the optimum, which are within controllable range.

The average shear strength parameters in terms of effective stress are 0.82 kg/cm^2 of cohesion and 34 degrees of internal friction angle, which are relatively high as this sort of fine materials.

These materials hence will be usable for either the regular core or the rock contact core.

(4) Borrow area Fb

Generally the materials in this borrow area are very similar to those in the borrow area Fa.

Although no natural moisture content test was conducted, these materials may be suitable either for regular core or for the rock contact core, preferably for the rock contact materials due to its fine grading nature.

(5) Borrow area C

The grading of the materials are fairly fine having - # 200 fraction of 76 % on average. It is characterized by its very high plasticity of approximately 20 % on average. These are classified as CH, MH and CL. These may suggest potentially higher compressibility than those in the other areas. However the high plastic characteristics may cope with the high compressibility from cracking.

The permeability is generally low, approximately 4 x 10^{-7} cm/s on average except one test result which shows higher permeability of 3 x 10^{-6} cm/s.

It is noted that the natural moisture contents are drier than the optimum by 0.8 % to 4.0 %, and 2.4 % on average, which could be much advantageous in the embankment work in the wet season.

Hence this area is considered suitable as source for core material.

(6) Borrow area D

The material properties of this borrow area are very similar to those in the borrow area Fa in respects of

either index properties or engineering properties. Hence these materials could be used for the core materials.

However a disadvantageous aspect of this borrow area is its location very far from the damsite.

(7) Borrow area B

Generally the material properties of this borrow area are very similar to those in the borrow area C except the plasticity.

The plasticity index of the materials is 8.1 %, which are much lower than that in the C.

It can be considered that this area is a stand-by borrow area in the wet season due to lower natural moisture content than that in the borrow area C.

(8) Borrow area I

The material properties of this borrow area is very similar to those of the borrow area C.

It can be considered that this area could be source for the core materials, although this area is located very far from the damsite.

(9) Borrow area Ea

The materials in this borrow area are very similar to those in the borrow area Fa.

The grading of the materials is generally fine having 84 % of - # 200 fraction. The average plasticity is approximately 12 %, which are fairy high and classified

as CL in the USC.

The average permeability is approximately 2 x 10^{-7} cm/s, which are low enough for the core materials.

The natural moisture content ranges from 1 % to 5 %, and 2.8 % on average, above the optimum.

The average shear strength parameters in terms of effective stress are 0.18 kg/cm^2 of cohesion and 30 degrees of internal friction angle, which are slightly lower than those in the borrow area Fa, but are considered reasonable as this sort of fine materials.

Hence, these materials could be used either as the regular core or as the rock contact core provided that proper moisture control be made.

(10) Borrow area Eb

The materials of this borrow area show similar properties of those in borrow area Ea except natural moisture conditions.

The natural moisture contents are fairly lower than the optimum by 3.7 %, which may suggest that the workability will be much superior in the wet season.

(11) Borrow area Ec

The materials in this borrow area are significantly coarser than those in the other borrow areas. The grading test results show that those have - # 200 fraction of 41 % on average, and gravel content of 22 % on average.

The plasticity index is 11.8 % on average, which are fairy high. These are mostly classified as SC or GC. The above may suggest that the compressibility will be very low, and high density could be attained after compaction.

It is however noted that the downstream area in the E3 consists of sandy materials classified as SP which is not suitable for the core (Refer to the results of test pit E-1 in Table B4).

The permeability varies from 1.9×10^{-7} to 2.8×10^{-6} cm/s, and 1.1×10^{-6} cm/s on average, which are very marginal in respect of the preferable permeability.

It is also noted that the natural moisture contents are wetter than the optimum by 2.0 % to 5.0 %, and 3.0 % on average, which are considered to be still in controllable range, but may be disadvantageous in the embankment work in the wet season.

The materials in this area will be usable for the regular core provided that proper moisture control be made.

3.1.3 Material quantity available

The quantity of materials in each borrow area is summarized as follows.

Borrow area	Estimated volume (x 1,000 m^3)
Aa	1,000
Ab	1,300
Fa	400
Fb	1,000
C	1,200
D	2,000
B	400
I	400
Ea	1,000
Eb	300
Ec	500

3.1.4 Conclusion

(1) The earth materials obtainable in the borrow areas Fa, Fb, C, D, I, Ea and Eb are suitable for both the regular core and the rock contact core.

(2) The earth materials obtained from the borrow area Ec are usable for the regular core, but not suitable for the rock contact core.

(3) The earth materials obtainable in the borrow area Aa and Ab are not suitable for the core.

(4) It is recommended that the priority be given to the borrow areas Ea and Fa to obtain the core materials for both the regular core and contact core taking into account the shorter hauling distance than the others.

(5) The borrow areas Eb and C should be considered as alternative borrow area in the wet season.

(6) Recommended design values of the core material are as follows.

Wet density	:	1.90 t/m^3
Saturated density	:	1.95 t/m^3
Cohesion		
Cuu	:	6.0 t/m^2
C'	:	1.5 t/m^2
Friction angle		
θuu	:	10 deg.
θ'	:	28 deg.
Permeability	:	1 x 10^{-5} cm/s

3.2 Sand and Gravel Materials

3.2.1 Material sources

Potential borrow areas of the filter materials and concrete aggregates investigated are Ga, Gb, Gc, Gd and Ge, which are riverbed deposits and Alluvial terrace deposits along the Ermenek river, as shown in Fig. B1. Geological conditions of test pits in those borrow areas are shown in Attachment B1.

3.2.2 Material properties

Properties required for the filter materials are as follows.

(1) $5 \times d_{15} < D_{15} < 5 \times d_{85}$

where:

D_{15}: Grain size at 15 % on grain size distribution curve of filter material.

d_{15}: Grain size at 15 % on grain size distribution curve of core material.

D_{85}: Grain size at 15 % on grain size distribution curve of core material.

If core material contains coarse grained materials, the above-mentioned relation could be applied to core materials excluding more than 25 mm grain size.

(2) It is better that the grain size distribution curve of filter materials will be nearly parallel to that of core materials.

(3) Filter materials should be without viscosity, and contain ratio of finer grained soils (not more than 0.074 mm) should be not more than 5 %.

The test results are summarized in Table B5 and as follows.

In the results of the abrasion test of Los Angels method, loss should be not more than 10 % after 100 revolutions and not more than 40 % after 500 revolutions. The average loss is 23.5 to 25.3 % after 500 revolutions in all the borrow areas.

Specific gravity, water absorption and soundness in all the borrow areas are as follows:

Specific gravity: 2.58 to 2.68 g/cm^3 on average for sand, and 2.58 to 2.67 g/cm^3 on average for gravel.

Water absorption: 1.7 to 3.9 % on average for sand, and 0.9 to 1.2 % on average for gravel.

Soundness : 8.8 to 13.1 % on average for sand, and 6.2 to 8.7 % on average for gravel.

The above results are all in acceptable range for filter materials and concrete aggregates.

Content of fine particles is 1 to 11 % in all the borrow areas except the test pit G-1 in the borrow area Ga. The G-1 show 27 %, being rather high.

Content of clay lumps in sand is 1.61 to 3.73 %, except G-1 in the borrow area Ga, 8.37 % in the Gb, 16.00 % in Gc, 1.62 to 2.21 % in Gd and 36.40 % in Ge. In general, acceptable range is not more than 5 % for filter materials, and not more than 1 % for concrete aggregates.

Alkali aggregate reactivity tests were performed for the materials of the test pits G-10, G-11, G-12 and G-13 in the borrow areas Gc, Gd and Ge, and the results are shown in Table B7. According to the test results, these materials are not detrimental for alkali aggregate reactivity, and these can be used together with those cements which meet the Turkish Standards.

Soft rock ratio tests were done for the materials in the test pits G-10, G-11, G-12 and G-13, and the results are shown in Table B8. The ratio is 3.5 % on average, in a range from 0.9 to 9.0 %.

3.2.3 Material quantity available

The quantity for each borrow area is estimated as follows.

Borrow area	Estimated quantity (x 1,000 m^3)
Ga	600
Gb	150
Gc	40
Gd	170
Ge	120

3.2.4 Conclusion

The materials from all the borrow areas will be acceptable in quality for the filter materials and concrete aggregates, although appropriate gradation control and washing will be required to use these materials.

3.3 Rock Materials

3.3.1 Quarry site location and quantity available

The location of quarry site is shown in Plate G27.

The quantity available is estimated as follows.

For concrete aggregates : 2,000,000 m^3
For embankment of rock zone: 13,500,000 m^3
(Refer to Plate G28.)

3.3.2 Material properties

The geological condition of quarry site is shown in Plates G28 and G29.

According to the boring investigations, core recovery percentage and RQD values are as follows.

Hole No.	Depth (m)	Core recovery (%)	RQD (%)	Weathering grade
311	2.00-30.00	97	32	c - e
	30.00-59.00	100	47	a - c
312	4.90-15.60	96	34	c - e
	15.60-50.00	100	61	a - c

(Weathering grade: Refer to Tables B10 to B12)

Depth of highly weathered zone (D to CL in rock classification of K.Kikuchi Et.al.) is about 20 meters in SK-311 and about 10 meters in SK-312.

Table B6 show the summary of laboratory test of quarry rock. The test results are as follows.

(1) Specific gravity

The result of specific gravity test, which is a useful index with respect to soundness and strength, ranges from 2.68 to 2.71 with an average value of 2.69. These values are higher than commonly allowable minimum value against concrete aggregate of 2.5.

(2) Absorption

The result of absorption test, which is necessary for concrete mix design as well as evaluation of quality, ranges from 0.35 to 3.37 x 10^{-3} %. These values are very small compared with allowable maximum value of 2 %.

(3) Compressive strength

The average value is 888 kg/cm^2, which is fairly high strength for the embankment materials and concrete aggregate.

(4) Super sonic test

Primary seismic velocity is 6,354 m/sec on average for all the samples taken below the depth of about 20 meters.

(5) Alkali aggregate reactivity

The test results are shown in Table B7. According to the results, these rocks are not detrimental for the alkali aggregate reactivity, and these can be used together with those cements which meet the Turkish Standard.

$CaCO_3$ amount is in a range of 94.3 to 95.3 %

3.3.3 Conclusion

The test results indicate that the rock materials obtainable in the quarry site is generally acceptable in quality. The rock materials obtained from the quarry site can be used for many objectives such as the rockfill material, transition material and filter material for the dam embankment, and the concrete aggregates.

TABLES

Table B1 WORK QUANTITY OF TEST PIT INVESTIGATION AND SAMPLING

BORROW AREA	PRE F/S STAGE			F/S STAGE		
	PIT NO.	DEPTH (m)	SAMPLE (nos)	PIT NO.	DEPTH (m)	SAMPLE (nos)
Aa	A-1	5.0	1			
	A-3	5.0	1			
Ab	A-2	4.0	1			
	A-4	3.0	1			
B	B-1	2.5	1			
C	C-1	5.0	1			
	C-2	3.0	1			
	C-3	5.0	1			
	C-4	2.0	1			
D	D-1	5.0	1			
	D-2	5.0	1			
	D-3	5.0	1			
	D-4	5.0	1			
E	E-1	3.5	1			
Ec				E-2	4.5	2
				E-3	3.2	2
Ea				E-4	3.5	2
				E-5	4.0	2
Eb				E-6	1.6	2
Fb	F-1	5.0	1			
	F-2	5.0	1			
	F-3	5.0	1			
Fa				F-4	3.5	2
				F-5	5.0	2
Ga	G-1	2.0	1			
	G-2	2.1	1			
	G-6	0.8	1			
Gb	G-5	0.8	1			
Gc	G-7	2.0	1	G-12	2.9	2
Gd	G-3	0.8	1	G-10	2.4	2
	G-4	1.7	1	G-11	1.8	2
Ge	G-8	3.6	1	G-13	2.0	2
	G-9	4.5	0			
H	H-1	3.0	1			
				H-2	1.0	0
				H-3	1.0	0
				H-4	1.0	0
				H-5	1.0	0
				H-6	1.0	0
I	I-1	3.0	1			
TOTAL	28	97.3	27	16	39.4	22

Notes:
(1) Borrow areas A, B, C, D, E, F, H & I ; for impervious materials.
(2) Borrow area Ga to Ge; for filter and concrete aggregate materials.
(3) Test pit H-1; downstream of I-B damsite.

Table B2 WORK QUANTITY OF LABORATORY TESTS

(1) Core Materials

Test item	Test quantity Pre-F/S stage	F/S stage	
Grain size analysis	19	14	samples
Natural moisture content	19	14	samples
Liquid & plastic limits	19	14	samples
Specific gravity	19	14	samples
Compaction test	19	14	cases
Permeability test	19	14	cases
Triaxial UU test	0	14	cases
Triaxial CŪ test	0	14	cases
Shear test	10	0	cases

(2) Filter Materials for Fill Dam and Concrete Aggregates

Test item	Test quantity Pre-F/S stage	F/S stage	
Grain size analysis	8	8	samples
Specific gravity & water absorption	8	12	samples
Soft rock ratio	0	4	samples
Soundness	8	12	samples
Abrasion	8	12	samples
Alkali aggregate reaction	0	12	samples

(3) Rock Materials for Fill Dam

Test item	Test quantity Pre-F/S stage	F/S stage	
Specific gravity & water absorption	0	17	samples
Unconfined compression test	0	17	samples
Super sonic wave test	0	17	samples

(4) Foundation Rock for Damsite I-C

Test item	Test quantity Pre-F/S stage	F/S stage	
Specific gravity & water absorption	0	18	samples
Unconfined compression test	0	18	samples
Super sonic wave test	0	18	samples

Table B3 LABOLATORY TEST METHOD (F/S STAGE)

1. Core materials

Test items	Test Method
Grain size analysis	ASTM D422-63
Natural moisture content	ASTM D2216-80
Liquid and plastic limits	ASTM D423-66, D424-59
Specific gravity	ASTM D854-58
Compaction test	ASTM D1557-78
Permeability test	Earth Manual E-13
Triaxial UU test	Earth Manual E-17
Triaxial CŪ test	Earth Manual E-17

2. Filter Materials and Concrete Aggregates

Test Items	Method
Grain size analysis	ASTM C136
Specific gravity and water absorption	ASTM C127, 128
Soft rock ratio	JIS A1126
Soundness	ASTM C88
Abrasion	ASTM C131
Alkali aggregate reaction	ASTM C289-87

3. Rock Materials and Foundation Rock in I-C damsite

Test Items	Method
Specific gravity and water absorption	ASTM C127
Unconfined compression test	ASTM D2938
Super sonic wave test	ASTM D2845-83

Table B4 SUMMARY OF LABORATORY TEST RESULTS : IMPERVIOUS CORE MATERIALS (1/4)

Borrow Area Aa

Test pit No.	Particle Size Distribution				Atterberg Limits				USC	Natural Moist. Content	Compaction		Triaxial Compression(CU)				Triaxial Compression(UU)		Shear Test				Permeability
	MGS (mm)	G (%)	S (%)	SC (%)	LL (%)	PL (%)	PI	BL		(%)	OMC (%)	rd max (t/m3)	Cu (kg/cm2)	ou (deg.)	c' (kg/cm2)	o (deg.)	Cu (kg/cm2)	ou (deg.)	c (kg/cm2)	o (deg.)	c' (kg/cm2)	o (deg.)	k (x10-5 cm/s)
A-1	9.52	3	31	66	33.7	25.0	8.7	19.9	OL-ML	17.9	17.5	1.72											0.1700
A-3	9.52	1	17	82	30.4	22.8	7.6	20.0	OL-ML	21.4	18.0	1.68											0.2200
Average	9.52	2	24	74	32.1	23.9	8.2	20.0		19.7	17.8	1.70											0.1950
Max.	9.52	3	31	82	33.7	25.0	8.7	20.0		21.4	18.0	1.72											0.2200
Min.	9.52	1	17	66	30.4	22.8	7.6	19.9		17.9	17.5	1.68											0.1700

Borrow Area Ab

Test pit No.	Particle Size Distribution				Atterberg Limits				USC	Natural Moist. Content	Compaction		Triaxial Compression(CU)				Triaxial Compression(UU)		Shear Test				Permeability
	MGS (mm)	G (%)	S (%)	SC (%)	LL (%)	PL (%)	PI	BL		(%)	OMC (%)	rd max (t/m3)	Cu (kg/cm2)	ou (deg.)	c' (kg/cm2)	o (deg.)	Cu (kg/cm2)	ou (deg.)	c (kg/cm2)	o (deg.)	c' (kg/cm2)	o (deg.)	k (x10-5 cm/s)
A-2	0.59	0	51	49					SP	13.7	13.0	1.84											1.2000
A-4	0.59	0	63	37					SP	9.7	13.2	1.81											1.4500
Average	0.59	0	57	43						11.7	13.1	1.83											1.3250
Max.	0.59	0	63	49						13.7	13.2	1.84											1.4500
Min.	0.59	0	51	37						9.7	13.0	1.81											1.2000

Borrow Area Fa

Test pit No.	Particle Size Distribution				Atterberg Limits				USC	Natural Moist. Content	Compaction		Triaxial Compression(CU)				Triaxial Compression(UU)		Shear Test				Permeability
	MGS (mm)	G (%)	S (%)	SC (%)	LL (%)	PL (%)	PI	BL		(%)	OMC (%)	rd max (t/m3)	Cu (kg/cm2)	ou (deg.)	c' (kg/cm2)	o (deg.)	Cu (kg/cm2)	ou (deg.)	c (kg/cm2)	o (deg.)	c' (kg/cm2)	o (deg.)	k (x10-5 cm/s)
F-4A	38.10	2	26	72	36.2	25.7	10.5		CL	17.0	15.0	1.87	1.14	39	1.12	39	0.82	9					0.0170
F-4B	38.10	8	35	57	37.2	23.7	13.5		CL	17.0	16.0	1.83	1.19	25	1.10	26	1.84	11					0.0210
F-5A	19.10	1	9	90	36.8	24.3	12.5		CL	17.0	12.0	1.88	0.62	39	0.66	38	1.73	21					0.0120
F-5B	19.10	2	8	90	37.0	21.4	15.6		CL	17.0	14.0	1.91	0.53	33	0.38	34	1.46	24					0.0130
Average	28.60	3	20	77	36.8	23.8	13.0			17.0	14.3	1.87	0.87	34	0.82	34	1.46	16					0.0158
Max.	38.10	8	35	90	37.2	25.7	15.6			17.0	16.0	1.91	1.19	39	1.12	26	1.84	24					0.0210
Min.	19.10	1	8	57	36.2	21.4	10.5			17.0	12.0	1.83	0.53	25	0.38	39	0.82	9					0.0120

(Source: EIE and the JICA Study Team)

Table B4 SUMMARY OF LABORATORY TEST RESULTS : IMPERVIOUS CORE MATERIALS (2/4)

Borrow Area Fb

Test pit No.	Particle Size Distribution				Atterberg Limits				USC	Natural Moist. Content	Compaction		Triaxial Compression(CU)				Triaxial Compression(UU)		Shear Test				Permeability
	MGS (mm)	G (%)	S (%)	SC (%)	LL (%)	PL (%)	PI	BL		(%)	OMC (%)	rd max (t/m3)	Cu (kg/cm2)	ou (deg.)	c' (kg/cm2)	o (deg.)	Cu (kg/cm2)	ou (deg.)	c (kg/cm2)	o (deg.)	c' (kg/cm2)	o (deg.)	k (x10-5 cm/s)
F-1	4.76	0	23	77	34.0	22.0	12.0	11.5	CL		18.5	1.70							0.81	21.7	0.89	25.5	0.0320
F-2	9.52	1	9	90	39.4	24.8	14.6	10.5	CL		20.3	1.64							0.45	20.0	0.56	22.0	0.0014
F-3	4.76	0	6	94	36.0	20.0	16.0	12.2	CL		16.5	1.67							0.58	22.0	0.67	25.6	0.0260
Average	6.35	0	13	87	36.5	22.3	14.2	11.4			18.4	1.67							0.61	21.2	0.70	24.4	0.0198
Max.	9.52	1	23	94	39.4	24.8	16.0	12.2			20.3	1.70							0.81	22.0	0.89	25.6	0.0320
Min.	4.76	0	6	77	34.0	20.0	12.0	10.5			16.5	1.64							0.45	20.0	0.56	22.0	0.0014

Borrow Area C

Test pit No.	Particle Size Distribution				Atterberg Limits				USC	Natural Moist. Content	Compaction		Triaxial Compression(CU)				Triaxial Compression(UU)		Shear Test				Permeability
	MGS (mm)	G (%)	S (%)	SC (%)	LL (%)	PL (%)	PI	BL		(%)	OMC (%)	rd max (t/m3)	Cu (kg/cm2)	ou (deg.)	c' (kg/cm2)	o (deg.)	Cu (kg/cm2)	ou (deg.)	c (kg/cm2)	o (deg.)	c' (kg/cm2)	o (deg.)	k (x10-5 cm/s)
C-1	9.52	2	17	81	60.5	26.6	33.9	20.7	CH	20.5	23.3	1.55											0.0320
C-2	9.52	2	21	77	31.7	19.3	12.4	12.8	CL	15.0	19.0	1.66											0.0280
C-3	19.10	7	21	72	56.1	33.4	22.7	24.3	OH-MH	20.3	21.1	1.56											0.3100
C-4	19.10	5	23	72	32.3	21.8	10.5	19.4	CL	17.7	19.5	1.65											0.0550
Average	14.31	4	21	76	45.2	25.3	19.9	19.3		18.4	20.7	1.61											0.1063
Max.	19.10	7	23	81	60.5	33.4	33.9	24.3		20.5	23.3	1.66											0.3100
Min.	9.52	2	17	72	31.7	19.3	10.5	12.8		15.0	19.0	1.55											0.0200

Borrow Area D

Test pit No.	Particle Size Distribution				Atterberg Limits				USC	Natural Moist. Content	Compaction		Triaxial Compression(CU)				Triaxial Compression(UU)		Shear Test				Permeability
	MGS (mm)	G (%)	S (%)	SC (%)	LL (%)	PL (%)	PI	BL		(%)	OMC (%)	rd max (t/m3)	Cu (kg/cm2)	ou (deg.)	c' (kg/cm2)	o (deg.)	Cu (kg/cm2)	ou (deg.)	c (kg/cm2)	o (deg.)	c' (kg/cm2)	o (deg.)	k (x10-5 cm/s)
D-1	19.10	2	9	89	34.5	22.5	12.0	9.0	CL-ML		18.5	1.72							0.17	24.9	0.20	28.7	0.0610
D-2	19.10	2	10	88	40.4	24.0	16.4	10.9	CL		19.2	1.67							0.51	25.8	0.57	29.8	0.0025
D-3	9.52	1	18	81	36.1	23.6	12.5	10.6	CL-ML		17.5	1.70							0.52	25.2	0.55	29.7	0.0410
D-4	4.76	0	6	94	38.7	23.4	15.3	9.5	CL		19.3	1.66							0.19	18.7	0.21	21.8	0.0180
Average	13.12	1	11	88	37.4	23.4	14.1	10.0			18.6	1.69							0.35	23.7	0.38	27.5	0.0306
Max.	19.10	2	18	94	40.4	24.0	16.4	10.9			19.3	1.72							0.52	25.8	0.57	29.8	0.0610
Min.	4.76	0	6	81	34.5	22.5	12.0	9.0			17.5	1.66							0.17	18.7	0.21	21.8	0.0025

(Source: EIE and the JICA Study Team)

Table B4 SUMMARY OF LABORATORY TEST RESULTS : IMPERVIOUS CORE MATERIALS (3/4)

Borrow Area B and I

Test pit No.	Particle Size Distribution				Atterberg Limits				USC	Natural Moist Content	Compaction		Triaxial Compression(CU)				Triaxial Compression(UU)		Shear Test				Permeability
	MGS (mm)	G (%)	S (%)	SC (%)	LL (%)	PL (%)	PI	BL		(%)	OMC (%)	rd max (t/m3)	Cu (kg/cm2)	ou (deg.)	c' (kg/cm2)	o (deg.)	Cu (kg/cm2)	ou (deg.)	c (kg/cm2)	o (deg.)	c' (kg/cm2)	o (deg.)	k (x10-5 cm/s)
B-1	4.76	0	17	83	29.5	21.4	8.1	17.5	CL	16.1	18.4	1.70											0.0410
I-1	19.10	3	21	76	49.3	30.4	18.9	17.3	ML		22.0	1.61							0.50	27.1	0.60	29.2	0.0220

Borrow Area Ea

Test pit No.	Particle Size Distribution				Atterberg Limits				USC	Natural Moist Content	Compaction		Triaxial Compression(CU)				Triaxial Compression(UU)		Shear Test				Permeability
	MGS (mm)	G (%)	S (%)	SC (%)	LL (%)	PL (%)	PI	BL		(%)	OMC (%)	rd max (t/m3)	Cu (kg/cm2)	ou (deg.)	c' (kg/cm2)	o (deg.)	Cu (kg/cm2)	ou (deg.)	c (kg/cm2)	o (deg.)	c' (kg/cm2)	o (deg.)	k (x10-5 cm/s)
E-4A	4.76	0	24	76	35.3	21.6	13.7		CL	20.0	18.5	1.69	0.23	28	0.11	31	0.61	14					0.0210
E-4B	4.76	0	21	79	35.6	21.5	14.1		CL	20.0	18.8	1.70	0.17	28	0.23	28	0.89	10					0.0220
E-5A	4.76	0	10	90	31.3	20.5	10.8		CL	23.0	17.6	1.76	0.30	27	0.11	32	0.70	4					0.0140
E-5B	4.76	0	10	90	30.4	20.3	10.1		CL	21.0	17.5	1.75	0.29	28	0.26	29	1.53	13					0.0120
Average	4.76	0	16	84	33.2	21.0	12.2			21.0	18.1	1.73	0.25	28	0.18	30	0.93	10					0.0173
Max.	4.76	0	24	90	35.6	21.6	14.1			23.0	18.8	1.76	0.30	28	0.26	32	1.84	14					0.0220
Min.	4.76	0	10	76	30.4	20.3	10.1			20.0	17.5	1.69	0.17	27	0.11	28	0.61	4					0.0120

Borrow Area Eb

Test pit No.	Particle Size Distribution				Atterberg Limits				USC	Natural Moist Content	Compaction		Triaxial Compression(CU)				Triaxial Compression(UU)		Shear Test				Permeability
	MGS (mm)	G (%)	S (%)	SC (%)	LL (%)	PL (%)	PI	BL		(%)	OMC (%)	rd max (t/m3)	Cu (kg/cm2)	ou (deg.)	c' (kg/cm2)	o (deg.)	Cu (kg/cm2)	ou (deg.)	c (kg/cm2)	o (deg.)	c' (kg/cm2)	o (deg.)	k (x10-5 cm/s)
E-6A	4.76	0	36	64	32.0	20.5	11.5		CL	17.0	20.8	1.67	0.19	28	0.23	29	0.98	1					0.0350
E-6B	4.76	0	25	75	36.3	25.5	10.8		CL	16.0	19.5	1.62	0.16	27	0.03	32	1.84	18					0.0290
Average	4.76	0	31	70	34.2	23.0	11.2			16.5	20.2	1.65	0.18	28	0.13	31	1.41	10					0.0320
Max.	4.76	0	36	75	36.3	25.5	11.5			17.0	20.8	1.67	0.19	28	0.23	32	1.84	18					0.0350
Min.	4.76	0	25	64	32.0	20.5	10.8			16.0	19.5	1.62	0.16	27	0.03	29	0.98	1					0.0290

(Source: EIE and the JICA Study Team)

Table B4 **SUMMARY OF LABORATORY TEST RESULTS : IMPERVIOUS CORE MATERIALS (4/4)**

Borrow Area Ec

Test pit No.	Particle Size Distribution				Atterberg Limits				USC	Natural Moist. Content	Compaction		Triaxial Compression(CU)				Triaxial Compression(UU)		Shear Test				Permeability
	MGS (mm)	G (%)	S (%)	SC (%)	LL (%)	PL (%)	PI	BL		(%)	OMC (%)	rd max (t/m3)	Cu (kg/cm2)	ou (deg.)	c' (kg/cm2)	o (deg.)	Cu (kg/cm2)	ou (deg.)	c (kg/cm2)	o (deg.)	c' (kg/cm2)	o (deg.)	k (x10-5 cm/s)
E-2A	38.10	15	36	49	36.4	25.1	11.3		SC-CL	21.0	16.0	1.86	0.92	30	0.90	30	0.92	19					0.2800
E-2B	90.00	45	26	29	38.0	25.0	13.0		GC-CL	19.0	16.0	1.88	0.77	31	0.68	32	1.85	20					0.1300
E-3A	38.10	19	30	51	33.7	23.0	10.7		CL	16.0	14.0	1.92	1.88	24	1.92	23	1.68	24					0.0200
E-3B	38.10	17	42	41	32.3	21.7	10.6		SC	16.0	14.0	1.94	0.46	36	0.32	37	1.38	15					0.0190
Average	51.08	24	34	43	35.1	23.7	11.4			18.0	15.0	1.90	1.01	30	0.96	31	1.46	20					0.1123
Max.	90.00	45	42	51	38.0	25.1	13.0			21.0	16.0	1.94	1.88	36	1.92	37	1.85	24					0.2800
Min.	38.10	15	26	29	32.3	21.7	10.6			16.0	14.0	1.86	0.46	24	0.32	23	0.92	15					0.0190

Other Test Results

Test pit No.	Particle Size Distribution				Atterberg Limits				USC	Natural Moist. Content	Compaction		Triaxial Compression(CU)				Triaxial Compression(UU)		Shear Test				Permeability
	MGS (mm)	G (%)	S (%)	SC (%)	LL (%)	PL (%)	PI	BL		(%)	OMC (%)	rd max (t/m3)	Cu (kg/cm2)	ou (deg.)	c' (kg/cm2)	o (deg.)	Cu (kg/cm2)	ou (deg.)	c (kg/cm2)	o (deg.)	c' (kg/cm2)	o (deg.)	k (x10-5 cm/s)
E-1	19.10	13	54	33					SP		14.3	1.85							0.21	35.3	0.19	40.3	1.4000
H-1	38.10	20	27	53	33.0	21.0	12.0	13.0	CL		13.1	1.74							0.25	31.9	0.24	36.7	0.0021

(Source: EIE and the JICA Study Team)

Table B5 SUMMARY OF LABORATORY TEST RESULTS : SAND AND GRAVEL MATERIALS (1/2)

BORROW AREA Ga

Test Pit No.	Unit Weight Sand (t/m3)	Unit Weight Gravel (t/m3)	Particle Size Distribution MGS (mm)	G (%)	S (%)	SC (%)	Passing No.200 sieve Sand (%)	Passing No.200 sieve Gravel (%)	Clay lumps Sand (%)	Clay lumps Gravel (%)	Specific Gravity Sand (g/cm3)	Specific Gravity Gravel (g/cm3)	Water Absorption Sand (%)	Water Absorption Gravel (%)	Soundness Sand (%)	Soundness Gravel (%)	Los Angels Abrasion (500cycles) (%)
G-1	1.46	1.76	50.80	33	40	27	40.00	3.90	57.20	2.56	2.52	2.69	3.9	0.8	11.5	8.3	22.6
G-2	1.74	1.62	50.80	61	36	3	8.00	0.10	3.73	0.20	2.60	2.67	3.3	1.0	10.8	6.6	23.9
G-6	1.71	1.79	76.20	58	39	3	8.20	0.20	1.61	0.33	2.63	2.66	3.7	1.2	11.0	11.0	23.9
Average	1.64	1.72		51	38	11	18.73	1.40	20.85	1.03	2.58	2.67	3.6	1.0	11.1	8.6	23.5
Max.	1.74	1.79	76.20	61	40	27	40.00	3.90	57.20	2.56	2.63	2.69	3.9	1.2	11.5	11.0	23.9
Min.	1.46	1.62	50.80	33	36	3	8.00	0.10	1.61	0.20	2.52	2.66	3.3	0.8	10.8	6.6	22.6

BORROW AREA Gb

Test Pit No.	Unit Weight Sand (t/m3)	Unit Weight Gravel (t/m3)	Particle Size Distribution MGS (mm)	G (%)	S (%)	SC (%)	Passing No.200 sieve Sand (%)	Passing No.200 sieve Gravel (%)	Clay lumps Sand (%)	Clay lumps Gravel (%)	Specific Gravity Sand (g/cm3)	Specific Gravity Gravel (g/cm3)	Water Absorption Sand (%)	Water Absorption Gravel (%)	Soundness Sand (%)	Soundness Gravel (%)	Los Angels Abrasion (500cycles) (%)
G-5	1.67		76.20	18	78	4	4.90	0.60	8.37	1.40	2.58	2.58	3.9	3.1	8.8	6.2	

BORROW AREA Gc

Test Pit No.	Unit Weight Sand (t/m3)	Unit Weight Gravel (t/m3)	Particle Size Distribution MGS (mm)	G (%)	S (%)	SC (%)	Passing No.200 sieve Sand (%)	Passing No.200 sieve Gravel (%)	Clay lumps Sand (%)	Clay lumps Gravel (%)	Specific Gravity Sand (g/cm3)	Specific Gravity Gravel (g/cm3)	Water Absorption Sand (%)	Water Absorption Gravel (%)	Soundness Sand (%)	Soundness Gravel (%)	Los Angels Abrasion (500cycles) (%)
G-7	1.59	1.69	76.20	56	33	11	24.00	0.60	16.00	0.94	2.60	2.66	3.3	1.1	12.3	6.0	24.4
G-12A			76.20	60	33	7					2.68	2.65	1.8	1.2	13.7	9.9	25.6
G-12B			76.20	66	29	5					2.61	2.65	2.9	1.2	13.3	8.2	26.6
Average			76.20	61	32	8					2.63	2.65	2.7	1.2	13.1	8.0	25.5
Max.				66	33	11					2.68	2.66	3.3	1.2	13.7	9.9	26.6
Min.				56	29	5					2.60	2.65	1.8	1.1	12.3	6.0	24.4

(Source: EIE and the JICA Study Team)

Notes: SC (silt - clay) of samples G-10A to G-13B; % of No.100 sieve passing.
G-1 to G-8; tested in 1987, G-10 to -13; tested in 1990.
MSC: Maximum gravel size. G: Gravel S: Sand

Table B5 **SUMMARY OF LABORATORY TEST RESULTS : SAND AND GRAVEL MATERIALS (2/2)**

BORROW AREA Gd

Test Pit No.	Unit Weight Sand (t/m3)	Unit Weight Gravel (t/m3)	Particle Size Distribution MGS (mm)	G (%)	S (%)	SC (%)	Passing No.200 sieve Sand (%)	Passing No.200 sieve Gravel (%)	Clay lumps Sand (%)	Clay lumps Gravel (%)	Specific Gravity Sand (g/cm3)	Specific Gravity Gravel (g/cm3)	Water Absorption Sand (%)	Water Absorption Gravel (%)	Soundness Sand (%)	Soundness Gravel (%)	Los Angels Abrasion (500cycles) (%)
G-3	1.79	1.69	76.20	43	53	4	7.30	0.50	1.62	0.13	2.63	2.65	2.5	1.1	7.8	8.8	25.0
G-4	1.82	1.69	76.20	46	48	6	10.50	0.20	2.21	0.48	2.65	2.67	2.5	0.9	8.3	10.6	25.0
G-10A			102.00	76	23	1					2.71	2.65	0.8	1.1	12.1	7.1	23.9
G-10B			102.00	70	29	1					2.70	2.70	1.2	0.5	10.1	13.5	28.6
G-11A			102.00	68	31	1					2.68	2.69	1.8	0.9	11.7	5.7	24.7
G-11B			102.00	59	40	1					2.70	2.66	1.6	1.0	12.7	6.2	24.6
Average	1.81	1.69		60	37	2	8.90	0.35	1.92	0.31	2.68	2.67	1.7	0.9	10.5	8.7	25.3
Max.			102.00	76	53	6					2.71	2.70	2.5	1.1	12.7	13.5	28.6
Min.			76.20	43	23	1					2.63	2.65	0.8	0.5	7.8	5.7	23.9

BORROW AREA Ge

Test Pit No.	Unit Weight Sand (t/m3)	Unit Weight Gravel (t/m3)	Particle Size Distribution MGS (mm)	G (%)	S (%)	SC (%)	Passing No.200 sieve Sand (%)	Passing No.200 sieve Gravel (%)	Clay lumps Sand (%)	Clay lumps Gravel (%)	Specific Gravity Sand (g/cm3)	Specific Gravity Gravel (g/cm3)	Water Absorption Sand (%)	Water Absorption Gravel (%)	Soundness Sand (%)	Soundness Gravel (%)	Los Angels Abrasion (500cycles) (%)
G-8	1.55		50.80	14	75	11	12.30	1.50	36.40	2.36	2.66	2.65	2.0	1.2	11.9	7.6	
G-13A			76.20	70	25	5					2.66	2.67	2.0	1.0	15.3	9.4	23.1
G-13B			76.20	56	34	10					2.65	2.66	2.5	1.1	14.7	6.5	24.7
Average				47	45	9					2.66	2.66	2.2	1.1	14.0	7.8	23.9
Max.			76.2	70	75	11					2.66	2.67	2.5	1.2	15.3	9.4	
Min.			50.8	14	25	5					2.65	2.65	2.0	1.0	11.9	6.5	

(Source: EIE and the JICA Study Team)

Notes: SC (silt - clay) of samples G-10A to G-13B; % of No.100 sieve passing.
G-1 to G-8; tested in 1987, G-10 to -13; tested in 1990.
MSC: Maximum gravel size. G: Gravel S: Sand

Table B6 SUMMARY OF LABORATORY TEST RESULTS : QUARRY SITE (SK-311 AND 312)

			Physical Test			Super Sonic Test						
Hole No.	Depth	(m)	Compressive strength (kg/cm2)	Water absorption (x10-3 %)	Bulk specific gravity (g/cm3)	Density (g/cm3)	Longt. velocity Vp(m/sn)	Transv. velocity Vs(m/sn)	Poisson's ratio	Dynum. shear modulus G(kg/cm2)	Dynum. elast. modulus E(kg/cm2)	Bulk modulus K(kg/cm2)
SK-311	12.20 -	12.50		2.50	2.70							
	12.80 -	12.95		1.24	2.69							
	18.80 -	19.15	1,322			2.89	6,468	3,147	0.34	297,508	797,324	830,546
	22.95 -	23.20	1,244	1.29		2.89	6,429	3,103	0.35	289,248	780,968	867,744
	32.65 -	32.87	170	1.65		2.72	5,586	2,793	0.33	220,551	586,664	575,162
	35.05 -	35.35	409	0.98		2.83	6,164	3,030	0.34	270,068	723,783	753,946
	44.70 -	44.90	617	1.36		2.89	6,436	3,066	0.35	282,386	762,440	847,157
	51.25 -	51.55		1.30	2.70							
	54.45 -	54.60	366	0.62		2.86	6,292	3,094	0.34	304,982	762,695	794,479
	55.05 -	55.30	1,509	3.37		2.88	6,409	3,147	0.34	296,478	794,560	827,670
	58.75 -	59.00	972	1.48	2.68	2.87	6,325	3,136	0.34	293,388	786,280	819,043
	Average		826	1.58	2.69	2.85	6,264	3,065	0.34	281,826	749,339	574,159
SK-312	15.70 -	16.10		0.35	2.71							
	21.60 -	21.90	1,313	1.50		2.88	6,389	3,194	0.33	305,400	812,364	796,437
	27.20 -	27.45	508	0.66		2.89	6,441	3,192	0.34	306,073	820,277	854,458
	31.25 -	31.55	441	0.61	2.68	2.89	6,468	3,264	0.33	320,043	851,317	834,624
	35.50 -	35.65	1,253	0.89		2.89	6,470	3,113	0.35	291,114	786,005	873,342
	37.00 -	37.30	685	2.10	2.68	2.89	6,435	3,159	0.34	299,782	803,411	836,888
	40.70 -	41.10	941	0.55	2.70	2.92	6,589	3,205	0.35	311,773	841,793	935,330
	43.90 -	44.10	1,301	1.50	2.69	2.87	6,351	3,147	0.34	295,448	791,797	824,784
	44.85 -	45.00	798	0.73		2.88	6,376	3,048	0.35	278,113	750,907	834,339
	45.00 -	45.35	1,244	0.79		2.88	6,389	3,194	0.33	305,400	812,364	796,437
	45.00 -	45.35		0.62								
	Average		943	0.94	2.69	2.89	6,434	3,168	0.34	301,461	807,804	842,960
	Average of all		888	1.24	2.69	2.87	6,354	3,120	0.34	292,221	780,291	817,787

AGGREGATE TEST RESULTS

Sample No.	Water absorption (%)	Bulk specific gravity (g/cm3)	Soundness (%)	Los Angeles Abrasion (500cycles, %)
SK-311A	0.10	2.68	0.2	23.2
SK-311B	0.10	2.69	2.8	21.1
SK-312A	0.20	2.66	3.9	25.5
SK-312B	0.10	2.70	1.1	23.6
Average	0.13	2.69	2.0	23.4

(Source: EIE and the JICA Study Team)

Table B7 RESULTS OF ALKALI AGGREGATE REACTIVITY TEST

(1) Sand and Gravel Materials

Sample No.	Decrease in Alkali (m mol/l)	Dissolved Silica (m mol/l)
G-10A	190	67
G-10B	150	64
G-11A	170	40
G-11B	130	19
G-12A	160	32
G-12B	190	56
G-13A	190	71
G-13B	180	71
Average	170	53

(2) Core Samples (Boreholes SK-311 and SK-312)

Sample No.	Decrease in Alkali (m mol/l)	Dissolved Silica (m mol/l)	Content Ratio of CaCO3 (%)
SK-311A	50	2	94.3
SK-311B	50	3	94.8
SK-312A	50	1	95.3
SK-312B	50	2	94.3
Average	50	2	94.7

(Source: EIE and the JICA Study Team)

Table B8 RESULTS OF SOFT ROCK RATIO TEST

Sample No.	Soft Rock Ratio (%)
G-10	2.3
G-11	0.9
G-12	1.9
G-13	9.0
Average	3.5

(Source: EIE and the JICA Study Team)

Table B9 GROUP SYMBOLS AND DESCRIPTION OF UNIFIED SOIL CLASSIFICATION

Group Symbols	Description
GW	Well graded gravels, gravel-sand mixtures, little or no fines
GP	Poorly graded gravels, gravel-sand mixtures, little or no fines
GM	Silty gravels, poorly graded gravel-sand-silt mixtures
GC	Clayey gravels, poorly graded gravel-sand-clay mixtures
SW	Well graded sands, gravelly sands, little or no fines
SP	Poorly graded sands, gravelly sands, little or no fines
SM	Silty sands, poorly graded sand-silt mixtures
SC	Clayey sands, poorly graded sand-clay mixtures
ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity
CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
OL	Organic silts and organic silt-clays of low plasticity
MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
CH	Inorganic clays of highly plasticity, fat clays
OH	Organic clays of medium to high plasticity
Pt	Peat and other highly organic soils

Remarks: Soils possessing characteristics of two groups are designated by combinations of symbols. For example GW-GC, well graded gravel-sand mixture with clay binder.

Source : Earth Manual

Table B10 ROCK PROPERTIES IN THE PROJECT AREA

Rock Classification for Ermenek Project

Hard Rock: Limestone, etc.			Medium Hard Rock: Sandstone, Conglomerate, etc.			Soft Rock: Marl, Siltstone, Schist, etc.		
Hard.	Weath.	Joint.	Hard.	Weath.	Joint.	Hard.	Weath.	Joint.
A	a	I						
A-B	b	I-III	B	a	I-III			
B	b-c	III-IV	B-C	a-c	III-IV			
C	c	IV-V	C	b-c	IV-V	C-D	a-b	I-IV
D	d	V	D	d	V	D	c-d	IV-V
E	e	VI	E	e	VI	E	e	VI

Rock Classification and Estimated Rock Properties (K.Kikuchi Et.al.)

	Static Modulus of Elasticity (kg/cm2)	Modulus of Deformation (kg/cm2)	Cohesion (kg/cm2)	Internal Friction Angle (degree)	Elastic Wave Velocity (km/sec)
A					
B	80,000 or more	50,000 or more	40 or more	55 to 65	3.7 or more
CH	80,000 to 40,000	50,000 to 20,000	40 to 20	40 to 55	3.7 to 3.0
CM	40,000 to 15,000	20,000 to 5,000	20 to 10	30 to 45	3.0 to 1.5
CL	15,000 or less	5,000 or less	10 or less	15 to 38	1.5 or less
D					

Notes.
Hard.: Hardness.
Weath.: Weathering condition.
Joint.: Joint frecuency.

Compressive Strength in Fresh Rock Condition (kg/cm2)	
Hard rock	More than "800 - 1,000"
Medium Hard Rock	"200 - 300" to "800 - 1,000"
Soft Rock	Less than "200 - 300"

Table B11 ROCK CLASSIFICATION FOR THE ERMENEK PROJECT

(1) HARDNESS

Class.	Explanation
A	Hard rocks. Very strong.
B	Medium hard rocks. Strong.
C	Soft rocks and moderately friable rocks. Moderately strong.
D	Very soft rocks and highly friable rocks. Weak.
E	Decomposed rocks. Rocks are almost decomposed by weathering, alteration and/or fault fracturing. Very weak.

(2) WEATHERING CONDITION

Class.	Explanation
a	Fresh rocks. No visible sign of weathering and discoloration on joint surface.
b	Slightly weathered rocks. Discoloration is generally seen on joint surface.
c	Moderately weathered rocks. Weathering is seen along some joints. Discoloration and thin weathered materials are generally seen on joint surface.
d	Highly weathered rocks. Weathering is seen along most of joints. Discoloration and rather thick weathered materials are observed on joint surface.
e	Decomposed rocks. Rocks are almost decomposed by weathering.

(3) JOINT SPACING

Class.		Spacing(cm)	Nos of joints(/m)
I	Extremely wide	More than 200	0
II	Very wide	60 - 200	0 - 2
III	Wide	20 - 60	2 - 5
IV	Moderately wide	6 - 20	5 - 20
V	Narrow	2 - 6	More than 20
VI	Very narrow	Less than 2	-

Table B12 ROCK CLASSIFICATION (K.KIKUCHI Et. al.) (1/4)

Rock class.	(1) Hard rocks
A	Very fresh in lithologic character. The rock-forming minerals of igneous rocks and the constituent grains of sedimentary rocks are not weathered and altered at all. Few joints are distributed. The rocks as a whole are very solid and densely hard.
B	Fresh in lithologic character. The rock-forming minerals of igneous rocks and the constituent grains of sedimentary rocks are little weathered and altered. Joints are sparsely distributed, assuring close adhesion. The rocks as a whole are solid and densely hard.
CH	Almost fresh, solid and hard in lithologic character. Among the rock-forming minerals of igneous rocks, feldspars and colored minerals such as mica and amphibole may be slightly weathered and altered. In sedimentary rocks feldspars and colored minerals existing secondary as constituent grains may be slightly weathered and altered. Joints are distributed considerably and joint walls are mostly weathered and altered, being discolored. Sometimes, weathered materials adhere thinly to joint walls. However, in general, the joints assure close adhesion. The rocks as a whole are solid and hard.
CM	Generally a little weathered and altered in lithologic character. In igneous rocks, feldspars and colored minerals excluding quartz are weathered, often being brown or reddish brown. In sedimentary rocks, feldspars and colored minerals existing secondarily as constituent grains are weathered and altered, often being brown or reddish brown as in case of igneous rocks. Joints are open and often hold clay or weathered materials. Rocks of this class often have many fine hair-like fissures. Therefore, when hit strongly by a rock hammer, they often collapse, being separated at the hair-like fissures. In addition, rocks which are fresh in lithologic character but have open joints distributed considerably to indicate cracky state are also included in this class.
CL	Since the rock-forming minerals of igneous rocks or the constituent grains of sedimentary rocks are considerably weathered, the rocks as a whole are generally brown or reddish brown. Joints are open, and hold clay and weathered materials considerably. In rocks of this class, fine hair-like fissures are distributed remarkably, and weathering occurs along the fissures. Therefore, even if hit lightly by a rock hammer, they easily collapse or are depressed. In addition, rocks which are fresh in lithologic character but have open joints considerably distributed to indicate masonry state are also included in this class.
D	The rock-forming minerals of igneous rocks or the constituent grains of sedimentary rocks are considerably weathered, and sandy and clayey portions are often seen. With rocks of this class, the distribution of joints is rather unclear.

Table B12 ROCK CLASSIFICATION (K.KIKUCHI Et. al.) (2/4)

Rock class.	(2) Medium hard rocks
A	
B	Fresh in lithologic character. The constituent grains are quite free from secondary weathering and alteration. Fissures of joints, etc. are little distributed. The rocks as a whole are solid and hard. In this case, those close to soft rocks which have the above properties may not belong to this class, but to class C.
CH	Fresh in lithologic character. The constituent grains are free from secondary weathering and alteration. Joints are sparsely distributed, assuring close adhesion. The rocks as a whole are almost solid and hard. In this case, those close to hard rocks may belong to class B.
CM	Feldspars and colored minerals existing secondarily as constituent grains are mostly a little weathered and altered. The weathering is not so intensive, but since the rocks are medium hard, they give a little soft impression in absolute hardness. Joints are distributed considerably, and most of them are a little open. The joints are weathered and altered, being discolored and often hold thin layers and weathered materials. Rocks of this class have hair-like fissures to some extent. Therefore, when hit by a rock hammer, they often collapse, being separated at the hair like fissure.
CL	Constituent grains are weathered and altered, and the degree of consolidation is very low. Since the rocks are medium hard, they give considerably soft impression in absolute hardness. Joints are considerably distributed. They are open, and hold weathered materials and clay layer considerably. Rocks of this class are considerably weathered along hair-like fissures, and when hit lightly by a rock hammer, they collapse easily.
D	Constituent grains are considerably weathered and altered, and the degree of consolidation is considerably low. They are often sandy and clayey. With rocks of this class, the distribution of fissures is rather unclear.

Table B12 ROCK CLASSIFICATION (K.KIKUCHI Et. al.) (3/4)

Rock class.	(3) Soft rocks
A	
B	
CH	Rock of this class are close to medium hard rocks (about 150 kg/cm^2 or more in the dry unconfined compression strength of fresh rocks). Fresh in lithologic character. Constituent grains are quite free from weathering and alteration, and joints are little distributed.
CM	Fresh in lithologic character. Constituent grains are free from secondary weathering and alteration. Joints are little or sparsely distributed, assuring close adhesion. The rocks as a whole are little weathered, but since they are soft, they give soft impression in absolute hardness. In this case, those less than about "60 to 70 kg/cm^2" in the dry unconfined compression strength do not belong to this class, but to class CL.
CL	Constituent grains are a little weathered and altered, and the degree of consolidation is very low. The rocks as a whole give very soft impression in absolute hardness. When the rocks are hit by the spire of rock hammer, the spire often sticks in them.
D	The degree of consolidation of constituent grains is very low, and most are sandy or clayey.

Table B12 ROCK CLASSIFICATION (K.KIKUCHI Et. al.) (4/4)

A. Description of Hard, Medium Hard and Soft Rocks

(1) Hard rocks

As an approximate criterion, rocks of more than "800 to 1000 kg/cm^2" in the unconfined compression strength of test pieces of fresh rocks. When hit by a rock hammer, they produce a metallic sound.

(2) Medium hard rocks

As an approximate criterion, rocks of "200 to 300 kg/cm^2" to "800 to 1,000 kg/cm^2" in the dry unconfined compression test of test pieces of rocks. when hit by a rock hammer, they produce a very tight sound, but generally do not produce a metallic sound. Of the rocks in this range, those rather soft may be depressed slightly on the surface, when hit by the spire of rock hammer.

(3) Soft rocks

As an approximate criterion, rocks of less than "200 to 300 kg/cm^2" in the dry unconfined compression test of test pieces of fresh rocks. When hit by a rock hammer, they produce a thick and loose sound, and may collapse. They are easily depressed on the surface, when hit by the spire of rock hammer.

B. Physical Properties of Rocks Corresponding to Each Rock Classification

Rock class.	Static modulus of elasticity (kg/cm^2)	Modulus of deformation (kg/cm^2)	Cohesion (kg/cm^2)	Internal friction angle (degree)	Elastic wave velocity (km/sec)
B	80,000 or more	50,000 or more	40 or more	55 - 65	3.7 or more
CH	80,000 - 40,000	50,000 - 20,000	40 - 20	40 - 55	3.7 - 3.0
CM	40,000 - 15,000	20,000 - 5,000	20 - 10	30 - 45	3.0 - 1.5
CL - D	15,000 or less	5,000 or less	10 or less	15 - 38	1.5 or less

(K.Kikuchi Et. al. Central Research Institute of Electric Power Industry, Japan.)