

1	00:00:53:14	00:00:56:26	Annenberg Media
2	00:00:56:28	00:01:43:18	§
3	00:01:43:20	00:01:47:04	<i>THROUGHOUT THE VAST REACHES</i>
4	00:01:47:06	00:01:49:29	<i>OF OUR SOLAR SYSTEM,</i>
5	00:01:50:01	00:01:52:02	<i>FROM THE TINIEST BITS</i>
6	00:01:52:04	00:01:55:09	<i>OF DUST AND ICE</i>
7	00:01:55:11	00:01:57:05	<i>TO THE HUGE</i>
8	00:01:59:29	00:02:02:00	<i>GASEOUS PLANETS,</i>
9	00:02:02:02	00:02:04:10	<i>CONDITIONS THAT MIGHT</i>
10	00:02:04:12	00:02:06:25	<i>SUPPORT LIFE AS WE KNOW IT</i>
11	00:02:06:27	00:02:10:07	<i>ARE CONSPICUOUSLY ABSENT.</i>
12	00:02:10:09	00:02:13:13	<i>ON VENUS, FOR EXAMPLE,</i>
13	00:02:13:15	00:02:16:28	<i>A DENSE NOXIOUS ATMOSPHERE</i>
14	00:02:18:20	00:02:22:05	<i>COMBINES</i>
15	00:02:22:07	00:02:24:15	<i>WITH A THICK CLOUD COVER</i>
16	00:02:24:17	00:02:27:02	<i>TO TRAP SOLAR ENERGY WITH</i>
17	00:02:27:04	00:02:30:01	<i>EXTRAORDINARY EFFICIENCY.</i>
18	00:02:30:03	00:02:33:03	<i>THE RESULT</i>
19	00:02:33:05	00:02:35:10	<i>IS A SURFACE TEMPERATURE</i>
20	00:02:35:12	00:02:37:26	<i>OF ABOUT 475 DEGREES</i>
21	00:02:41:10	00:02:44:02	<i>CENTIGRADE.</i>
22	00:02:44:04	00:02:45:17	<i>ON MARS, CONDITIONS</i>
23	00:02:45:19	00:02:47:22	<i>ARE NOT QUITE SO BRUTAL,</i>
24	00:02:47:24	00:02:50:20	<i>BUT HARDLY CONDUCIVE</i>
25	00:02:50:22	00:02:53:23	<i>TO LIFE.</i>
26	00:02:53:25	00:02:56:20	<i>THE MEAN SURFACE TEMPERATURE</i>
27	00:02:56:22	00:02:59:15	<i>ON THE RED PLANET</i>
28	00:02:59:17	00:03:02:06	<i>IS MINUS 23 DEGREES</i>
29	00:03:03:13	00:03:05:22	<i>CENTIGRADE.</i>
30	00:03:05:24	00:03:09:28	<i>AND THE MARTIAN ATMOSPHERE</i>
31	00:03:19:23	00:03:23:16	<i>IS VERY THIN,</i>
32	00:03:23:18	00:03:25:01	<i>IS VERY THIN,</i>

33	00:03:25:03	00:03:28:01	EARTH IS THE IDEAL HABITAT
		FOR LIFE,	
34	00:03:28:03	00:03:31:01	THE ONLY SUCH PLACE
			IN OUR SOLAR SYSTEM.
35	00:03:31:03	00:03:33:29	TO UNDERSTAND WHY THE EARTH
			IS SO EXTRAORDINARY,
36	00:03:34:01	00:03:36:13	IT'S NECESSARY TO TRACE
			THE HISTORICAL DEVELOPMENT
37	00:03:36:15	00:03:37:28	OF OUR PLANET
38	00:03:38:00	00:03:40:12	AND TO UNDERSTAND
			THE PROCESSES OF NATURE
39	00:03:40:14	00:03:41:27	WHICH OPERATE TODAY.
40	00:03:41:29	00:03:44:27	THIS IS WHAT THE SCIENCE
			OF GEOLOGY IS ALL ABOUT.
41	00:03:44:29	00:03:46:12	GEOLOGISTS DO MORE
42	00:03:46:14	00:03:48:14	THAN COLLECT ROCKS
			AND CATALOG FOSSILS.
43	00:03:48:16	00:03:50:25	GEOLOGY IS THE STUDY
			OF THE WHOLE EARTH,
44	00:03:50:27	00:03:52:26	AND THE GOAL
			OF GEOLOGIC RESEARCH
45	00:03:52:28	00:03:55:11	IS TO UNDERSTAND
			AS BEST WE CAN
46	00:03:55:13	00:03:57:06	HOW THE ENTIRE
			EARTH WORKS.
47	00:03:58:13	00:03:59:23	<i>THIS PLANET'S</i>
			<i>GEOLOGIC ACTIVITY</i>
48	00:03:59:25	00:04:02:23	<i>IS DRIVEN BY</i>
			<i>WHAT GEOLOGISTS REFER TO</i>
49	00:04:02:25	00:04:04:23	<i>AS EARTH'S</i>
			<i>TWO HEAT ENGINES,</i>
50	00:04:04:25	00:04:08:27	<i>ONE INTERNAL,</i>
			<i>THE OTHER EXTERNAL.</i>
51	00:04:10:14	00:04:13:17	<i>THESE ARE DYNAMIC PROCESSES</i>
			<i>THAT CONVERT HEAT ENERGY</i>
52	00:04:13:19	00:04:15:19	<i>INTO MECHANICAL ENERGY,</i>
53	00:04:15:21	00:04:18:24	<i>WHICH IN TURN</i>
			<i>CAUSES GEOLOGIC CHANGE.</i>
54	00:04:22:16	00:04:24:13	<i>THE EARTH'S</i>
			<i>INTERNAL HEAT ENGINE</i>
55	00:04:24:15	00:04:28:03	<i>IS POWERED BY HEAT</i>
			<i>FROM RADIOACTIVE DECAY</i>
56	00:04:28:05	00:04:29:19	<i>DEEP WITHIN OUR PLANET.</i>
57	00:04:29:21	00:04:32:19	<i>IT DRIVES A PROCESS</i>
			<i>KNOWN AS CONVECTION,</i>
58	00:04:32:21	00:04:34:04	<i>WHICH CAUSES HOT MATERIAL</i>
59	00:04:34:06	00:04:37:05	<i>TO FLOW FROM THE INTERIOR</i>
			<i>OF THE EARTH</i>
60	00:04:37:07	00:04:39:28	<i>SLOWLY TOWARD</i>
			<i>THE COOLER SURFACE.</i>
61	00:04:40:00	00:04:43:25	<i>EARTHQUAKES AND VOLCANOES</i>
			<i>ARE RESULTS OF CONVECTION.</i>
62	00:04:46:12	00:04:48:24	<i>THE EARTH'S</i>
			<i>EXTERNAL HEAT ENGINE</i>
63	00:04:48:26	00:04:52:15	<i>IS ESSENTIALLY</i>
			<i>SOLAR-POWERED.</i>

64	00:04:52:17	00:04:54:14	<i>IT SETS IN MOTION</i>
65	00:04:54:16	00:04:57:16	<i>A CYCLE KNOWN AS THE</i>
			<i>HYDROLOGIC OR WATER CYCLE</i>
66	00:04:57:18	00:04:59:02	<i>THAT HAS</i>
			<i>IMPORTANT RAMIFICATIONS</i>
67	00:04:59:04	00:05:01:17	<i>FOR THE LANDSCAPE</i>
			<i>OF THIS PLANET.</i>
68	00:05:01:19	00:05:03:03	<i>[THUNDER]</i>
69	00:05:03:05	00:05:07:09	<i>WHEN RAIN OR SNOW FALLS</i>
			<i>ON THE LAND'S SURFACE,</i>
70	00:05:07:11	00:05:09:02	<i>MORE THAN HALF THE WATER</i>
71	00:05:09:04	00:05:11:05	<i>RETURNS TO THE ATMOSPHERE</i>
			<i>BY EVAPORATION</i>
72	00:05:11:07	00:05:13:22	<i>OR BY TRANSPIRATION</i>
			<i>FROM PLANTS.</i>
73	00:05:15:27	00:05:19:24	<i>THE REMAINDER PERCOLATES</i>
			<i>DOWN INTO THE EARTH</i>
74	00:05:19:26	00:05:21:23	<i>TO BECOME GROUND WATER</i>
75	00:05:21:25	00:05:24:22	<i>OR FLOWS OVER</i>
			<i>THE LAND'S SURFACE</i>
76	00:05:24:24	00:05:26:26	<i>AS RUNOFF</i>
			<i>IN STREAMS AND RIVERS.</i>
77	00:05:28:29	00:05:30:12	<i>OVER LONG PERIODS OF TIME,</i>
78	00:05:30:14	00:05:33:11	<i>THIS MOISTURE</i>
			<i>AT THE EARTH'S SURFACE</i>
79	00:05:33:13	00:05:36:24	<i>HELPS ROCKS DECOMPOSE,</i>
			<i>FORMING SOIL.</i>
80	00:05:36:26	00:05:40:20	<i>WATER WASHING DOWN HILLSIDES</i>
			<i>AND FLOWING IN STREAMS</i>
81	00:05:40:22	00:05:42:21	<i>LOOSENS AND CARRIES AWAY</i>
82	00:05:42:23	00:05:45:08	<i>THE ROCK</i>
			<i>AND SOIL PARTICLES.</i>
83	00:05:45:10	00:05:47:24	<i>THE EARTH'S TWO</i>
			<i>HEAT ENGINES</i>
84	00:05:47:26	00:05:50:03	<i>DO NOT WORK IN ISOLATION.</i>
85	00:05:50:05	00:05:52:18	<i>INSTEAD, THEY</i>
			<i>PERFORM A KIND</i>
86	00:05:52:20	00:05:54:23	<i>OF ONGOING BALANCING ACT.</i>
87	00:05:54:25	00:05:56:08	<i>MOUNTAINS ORIGINALLY RAISED</i>
88	00:05:56:10	00:05:58:16	<i>BY THE EARTH'S</i>
			<i>INTERNAL FORCES</i>
89	00:05:58:18	00:06:01:01	<i>ARE WORN AWAY</i>
			<i>BY WEATHERING AND EROSION</i>
90	00:06:01:03	00:06:03:18	<i>DRIVEN BY</i>
			<i>THE EXTERNAL HEAT ENGINE.</i>
91	00:06:06:16	00:06:09:19	<i>THESE HEAT ENGINES</i>
			<i>WORKING TOGETHER</i>
92	00:06:09:21	00:06:13:09	<i>PROVIDE THE FUEL FOR THIS</i>
			<i>ENORMOUSLY COMPLEX MACHINE</i>
93	00:06:13:11	00:06:14:28	<i>WE CALL EARTH.</i>
94	00:06:15:00	00:06:17:26	<i>IT IS THE DETAILED WORKINGS</i>
			<i>OF THIS DYNAMIC PLANET</i>
95	00:06:17:28	00:06:20:05	<i>THAT GEOLOGISTS ARE CONTINUALLY TRYING</i>
96	00:06:20:07	00:06:21:23	<i>TO BETTER UNDERSTAND.</i>
97	00:06:23:12	00:06:25:24	<i>THERE'S NEVER BEEN A MORE EXCITING TIME</i>
98	00:06:25:26	00:06:28:08	<i>TO STUDY GEOLOGY THAN RIGHT NOW.</i>

99	00:06:28:10	00:06:29:23	SINCE THE 1960s,
100	00:06:29:25	00:06:32:02	EARTH SCIENCE HAS UNDERGONE SOMETHING
			OF A RENAISSANCE
101	00:06:32:04	00:06:35:12	AS NEW EVIDENCE ABOUT THE WAY THE EARTH
			WORKS
102	00:06:35:14	00:06:37:11	HAS REPLACED OLD SIMPLISTIC PERCEPTIONS.
103	00:06:37:13	00:06:39:12	THIS NEW KNOWLEDGE HAS BEEN BLENDED
104	00:06:39:14	00:06:41:11	INTO A SINGLE INCLUSIVE THEORY
105	00:06:41:13	00:06:43:13	OF EARTH HISTORY AND FUNCTION--
106	00:06:43:15	00:06:45:13	THE THEORY OF PLATE TECTONICS.
107	00:06:45:15	00:06:48:13	WE NOW KNOW THAT THE OUTER SKIN OF THE
			EARTH
108	00:06:48:15	00:06:50:23	IS COMPOSED OF INDIVIDUAL PIECES OR PLATES
109	00:06:50:25	00:06:52:09	THAT SLIDE AROUND
110	00:06:52:11	00:06:54:15	ON A PARTIALLY MOLTEN LAYER BELOW.
111	00:06:54:17	00:06:57:15	GEOLOGISTS ARE STRUGGLING TO UNDERSTAND
			THE PROCESSES
112	00:06:57:17	00:06:59:00	WHICH MOVE THE PLATES
113	00:06:59:02	00:07:01:27	AND THE INTERACTIONS BETWEEN THE PLATES
			THEMSELVES.
114	00:07:01:29	00:07:03:12	BUT TODAY,
115	00:07:03:14	00:07:05:28	THERE IS PERHAPS AN EVEN MORE COMPELLING
			REASON
116	00:07:06:00	00:07:08:12	FOR UNRAVELING THE MYSTERIES OF THE
			EARTH'S INTERIOR--
117	00:07:08:14	00:07:11:11	THE NEED TO LOCATE THE NATURAL RESOURCES
118	00:07:11:13	00:07:13:12	UPON WHICH CIVILIZATION DEPENDS--
119	00:07:13:14	00:07:17:06	MINERALS, PETROLEUM, FRESH WATER, FERTILE
			SOIL.
120	00:07:17:08	00:07:20:06	THESE NATURAL RESOURCES ARE NOT IN
			UNLIMITED SUPPLY,
121	00:07:20:08	00:07:24:04	AND WE ARE CONSUMING THEM FASTER THAN
			THEY ARE FORMED.
122	00:07:24:06	00:07:27:05	GEOLOGISTS PLAY A CRUCIAL ROLE IN THIS
			CHALLENGE.
123	00:07:27:07	00:07:30:06	USING THEIR KNOWLEDGE OF THE WAY THE
			EARTH WORKS,
124	00:07:30:08	00:07:33:06	THEY UNCOVER NEW SOURCES OF MINERALS
			AND FUELS
125	00:07:33:08	00:07:36:04	AND PLAN WAYS TO EXTRACT THEM
			ECONOMICALLY
126	00:07:36:06	00:07:39:06	AND WITH MINIMAL HARM TO THE ENVIRONMENT.
127	00:07:41:26	00:07:44:24	<i>GEOLOGIC RESOURCES ARE ESSENTIAL</i>
128	00:07:44:26	00:07:46:09	<i>FOR MODERN CIVILIZATION.</i>
129	00:07:46:11	00:07:48:10	<i>WITH THE EXCEPTION OF SOLAR ENERGY,</i>
130	00:07:48:12	00:07:50:14	<i>NEARLY EVERYTHING HUMANS DEPEND ON</i>
131	00:07:50:16	00:07:52:06	<i>COMES FROM THE EARTH.</i>
132	00:07:54:14	00:07:57:18	EVERYTHING WE BUILT OUR CIVILIZATION WITH--
133	00:07:57:20	00:08:00:18	OUR HOMES, THE CAR THAT YOU DROVE IN WITH
			TODAY
134	00:08:00:20	00:08:03:18	WHAT WAS IT MADE OF, HOW IT WAS FUELED--
135	00:08:03:20	00:08:06:03	THE CHAIR YOU'RE SITTING ON, OR YOUR DESK,
136	00:08:06:05	00:08:07:19	THE PENCIL YOU WRITE WITH--
137	00:08:07:21	00:08:10:18	ALL THE MATERIALS WE LIVE WITH ON AN
			EVERYDAY BASIS
138	00:08:10:20	00:08:12:04	COME FROM THE EARTH.

139 00:08:12:06 00:08:15:03 SOMEHOW THEY'VE GOT TO BE EXTRACTED FROM
 THE EARTH,
 140 00:08:15:05 00:08:17:17 AND THE GEOLOGIST HAS THAT PRINCIPAL ROLE.
 141 00:08:17:19 00:08:20:17 WHILE THERE IS A WIDE RANGE OF RESOURCES
 142 00:08:20:19 00:08:23:12 WHICH PLAY KEY ROLES IN MODERN CIVILIZATION,
 143 00:08:23:14 00:08:25:20 IT IS PETROLEUM
 144 00:08:25:22 00:08:29:03 THAT GARNERS MOST
 OF THE WORLD'S ATTENTION.
 145 00:08:29:05 00:08:31:17 FOR GEOPHYSICIST STEPHEN SCOTT,
 146 00:08:31:19 00:08:36:26 THE SEARCH FOR OIL AND GAS
 IS AN ONGOING CHALLENGE.
 147 00:08:36:28 00:08:39:26 OIL COMPANIES TYPICALLY USE SEISMIC STUDIES
 148 00:08:39:28 00:08:41:09 OF EARTH'S CRUST
 149 00:08:41:11 00:08:43:26 TO ASSIST IN LOCATING RESERVES.
 150 00:08:45:18 00:08:49:16 ONE TECHNIQUE KNOWN AS REFLECTION
 SEISMOLOGY
 151 00:08:49:18 00:08:51:01 IS ESPECIALLY USEFUL.
 152 00:08:52:24 00:08:55:06 IN REFLECTION SEISMOLOGY,
 WHAT WE TRY TO DO
 153 00:08:55:08 00:08:59:26 IS GENERATE THAT SOURCE
 OR THAT SHOCK WAVE OURSELF
 154 00:08:59:28 00:09:03:10 AND TRY TO REFLECT THAT
 OFF OF SUBSURFACE ROCKS
 155 00:09:03:12 00:09:07:02 AND RECORD IT AT THE SURFACE
 WITH GEOPHONES.
 156 00:09:07:04 00:09:11:02 WE DO THAT BY SENDING OUT
 A TRUCK INTO THE FIELD.
 157 00:09:11:04 00:09:13:18 WE HAVE A TRUCK CALLED
 A VIBROSEIS TRUCK
 158 00:09:13:20 00:09:15:19 THAT ACTUALLY
 SHAKES THE GROUND.
 159 00:09:15:21 00:09:17:26 A VIBROSEIS TRUCK
 WOULD SHAKE THE GROUND
 160 00:09:17:28 00:09:19:25 IN AN UP AND DOWN FASHION,
 161 00:09:19:27 00:09:23:24 MUCH LIKE A JACKHAMMER
 ON A CONSTRUCTION SITE
 SHAKES THE GROUND.
 162 00:09:23:26 00:09:27:09 SO WHAT WE'RE TRYING TO DO
 IS USE A TECHNOLOGY
 163 00:09:27:11 00:09:31:08 SO WE CAN SEE THE SECRETS
 OF THE EARTH BELOW.
 164 00:09:32:27 00:09:34:26 BECAUSE THE SHOCK WAVES
 INTERACT DIFFERENTLY
 165 00:09:34:28 00:09:36:16 WITH DIFFERENT KINDS
 OF ROCK,
 166 00:09:36:18 00:09:39:11 REFLECTION SEISMOLOGY
 HELPS GEOPHYSICISTS
 167 00:09:39:13 00:09:41:10 FIND GEOLOGIC STRUCTURES
 168 00:09:41:12 00:09:44:06 THAT COMMONLY CONTAIN
 OIL AND GAS.
 169 00:09:47:02 00:09:48:29 SUCH STRUCTURES
 CAN BE DETECTED
 170 00:09:49:01 00:09:51:00 NOT ONLY
 BY SEISMIC TECHNIQUES,
 171 00:09:51:02 00:09:55:01 BUT BY OBSERVATION FROM
 AIRCRAFT OR SATELLITE AS WELL.

172 00:09:55:03 00:09:57:06 *THIS METHOD
OF LONG-DISTANCE VIEWING*

173 00:09:57:08 00:09:59:17 *IS CALLED REMOTE SENSING.*

174 00:09:59:19 00:10:03:04 *IT'S A WAY OF LOOKING
AT VERY LARGE AREAS
VERY QUICKLY*

175 00:10:03:06 00:10:04:20 *AND GETTING AN OVERVIEW.*

176 00:10:04:22 00:10:08:12 *PARTICULARLY SINCE THE ADVENT
OF SATELLITE REMOTE SENSING,*

177 00:10:08:14 00:10:10:01 *WE HAVE HAD THE LUXURY*

178 00:10:10:03 00:10:13:24 *OF BEING ABLE TO LOOK
AT VERY LARGE AREAS
OF THE EARTH'S SURFACE*

179 00:10:13:26 00:10:17:11 *AND GET AN INTEGRATED IDEA
OF WHAT'S GOING ON.*

180 00:10:17:13 00:10:18:25 *WHAT REMOTE SENSING
HAS DONE--*

181 00:10:18:27 00:10:20:11 *OR SATELLITE REMOTE SENSING,
PARTICULARLY--*

182 00:10:20:13 00:10:25:02 *HAS GIVEN US A CHANCE TO
LOOK AT THE INTERRELATIONSHIP*

183 00:10:25:04 00:10:28:14 *BETWEEN WIDELY SEPARATED
FEATURES*

184 00:10:28:16 00:10:33:23 *AND SEE THOSE IN A WAY
THAT WE'VE NOT BEEN ABLE
TO SEE IT BEFORE.*

185 00:10:35:01 00:10:37:05 *IN ONE
RECENT INVESTIGATION*

186 00:10:37:07 00:10:39:18 *OF THE POTENTIAL
OIL AND GAS RESERVES*

187 00:10:39:20 00:10:40:29 *OF PAKISTAN,*

188 00:10:41:01 00:10:43:23 *28 SEPARATE IMAGES
WERE COMBINED*

189 00:10:43:25 00:10:45:07 *TO FORM A MOSAIC,*

190 00:10:45:09 00:10:46:22 *WHICH SHOWED NUMEROUS*

191 00:10:46:24 00:10:48:26 *SPECTACULAR
GEOLOGIC STRUCTURES.*

192 00:10:50:09 00:10:51:26 *BECAUSE OF
THEIR REMOTENESS,*

193 00:10:51:28 00:10:56:11 *MANY HAD NOT BEEN SEEN
BY GROUND-BASED GEOLOGISTS.*

194 00:10:56:13 00:10:58:27 *THIS OPENED UP NEW AREAS*

195 00:10:58:29 00:11:01:11 *FOR OIL
AND GAS EXPLORATION.*

196 00:11:01:13 00:11:04:13 *BUT REMOTE SENSING
IS BY NO MEANS LIMITED*

197 00:11:04:15 00:11:07:21 *TO THE SEARCH
FOR NEW SOURCES OF ENERGY.*

198 00:11:07:23 00:11:09:21 *IT HAS ALSO BEEN USED*

199 00:11:09:23 00:11:11:25 *TO STUDY CHANGING
VEGETATION PATTERNS,*

200 00:11:11:27 00:11:13:11 *LOCATE MINERAL DEPOSITS,*

201 00:11:13:13 00:11:15:01 *TRACK POLLUTANTS,*

202 00:11:15:03 00:11:17:12 *AND SEARCH FOR ANOTHER
CRITICAL RESOURCE--*

203 00:11:17:14 00:11:19:02 *GROUND WATER.*

204 00:11:22:06 00:11:25:26 THE AMOUNT OF WATER LYING
UNDERGROUND IS VAST--
205 00:11:25:28 00:11:28:25 MORE THAN 30 TIMES
THE TOTAL SUPPLY OF WATER
206 00:11:28:27 00:11:31:18 STORED IN ALL THE WORLD'S
LAKES AND RIVERS.
207 00:11:31:20 00:11:34:04 CIVILIZATION DEPENDS
HEAVILY ON GROUND WATER,
208 00:11:34:06 00:11:37:01 AND AS POPULATION RISES,
209 00:11:37:03 00:11:40:00 THIS RESOURCE BECOMES
INCREASINGLY VALUABLE.
210 00:11:40:02 00:11:43:26 THE THING IS
THAT GROUND WATER
IS ALMOST ALWAYS THERE,
211 00:11:43:28 00:11:47:07 BUT IT MAY BE TOO DEEP
TO BE ECONOMICAL
TO DRILL.
212 00:11:47:09 00:11:49:20 IT ALSO MAY NOT BE
OF GOOD PURITY.
213 00:11:49:22 00:11:51:20 TODAY WE HAVE
SEVERE PROBLEMS
214 00:11:51:22 00:11:52:27 WITH POLLUTION,
CONTAMINATION,
215 00:11:52:29 00:11:55:12 AND GROUND WATER,
AS WE GO DEEPER,
216 00:11:55:14 00:11:56:26 GETS OLDER, HOTTER,
AND SALTIER,
217 00:11:56:28 00:12:00:07 SO YOU DON'T WANT
TO GO REAL DEEP.
218 00:12:00:09 00:12:02:06 IN THE SOUTHERN
CALIFORNIA AREA,
219 00:12:02:08 00:12:04:29 THERE ARE A NUMBER
OF FACTORS
220 00:12:05:01 00:12:07:16 THAT CREATE A FAVORABLE
ENVIRONMENT FOR GROUND WATER,
221 00:12:07:18 00:12:10:01 INCLUDING
VERY PERMEABLE SOILS,
222 00:12:10:03 00:12:11:17 A LARGE STORAGE CAPACITY,
223 00:12:11:19 00:12:14:27 AND A STEADY SUPPLY
OF SURFACE WATER.
224 00:12:16:12 00:12:19:19 AT THE ORANGE COUNTY
WATER DISTRICT,
225 00:12:19:21 00:12:21:07 JIM GOODRICH
IS RESPONSIBLE
226 00:12:21:09 00:12:23:16 FOR MANAGING
THE GROUND WATER SUPPLY.
227 00:12:23:18 00:12:26:01 HE IS CONCERNED
BOTH WITH THE QUANTITY
228 00:12:26:03 00:12:29:00 AND THE QUALITY
OF AVAILABLE WATER.
229 00:12:30:15 00:12:33:12 SO WHAT WE'VE DONE
IN ORANGE COUNTY IS DEVELOP
230 00:12:33:14 00:12:37:08 A VERY SOPHISTICATED
GROUND WATER
MONITORING PROGRAM
231 00:12:37:10 00:12:40:17 WHICH USES

232 00:12:40:19 SURFACE WATER SAMPLING,
 233 00:12:42:22 00:12:42:20 PRODUCTION WELL SAMPLING,
 00:12:46:27 AND DEDICATED
 MONITORING WELL SAMPLING.
 234 00:12:46:29 00:12:48:13 OUR MONITORING WELLS
 235 00:12:48:15 00:12:51:11 ARE DRILLED TO A DEPTH
 OF ABOUT 1,500 FEET
 236 00:12:51:13 00:12:55:14 AND ISOLATE
 AND TAP UP TO 18 ZONES
 237 00:12:55:16 00:12:57:14 THAT WE CAN MONITOR
 INDIVIDUALLY,
 238 00:12:57:16 00:13:01:19 SO THAT IF A CONTAMINANT
 IS COMING TOWARDS US,
 239 00:13:01:21 00:13:03:20 TOWARDS A PRODUCTION WELL,
 240 00:13:03:22 00:13:06:21 WE CAN FIND IT
 BEFORE IT BECOMES A PROBLEM
 241 00:13:06:23 00:13:10:14 AND INSTITUTE A MITIGATION.
 242 00:13:12:11 00:13:15:19 *LIKE WATER, SOIL IS*
A GEOLOGICAL RESOURCE
 243 00:13:15:21 00:13:19:25 *ESSENTIAL TO*
SUSTAINING CIVILIZATION.
 244 00:13:19:27 00:13:23:04 *FOR FARMERS*
LIKE WAYNE SOPPELAND,
 245 00:13:23:06 00:13:25:05 *WHO LIVES IN CALIFORNIA'S*
MOJAVE DESERT,
 246 00:13:25:07 00:13:28:09 *MAINTAINING A FERTILE,*
PLENTIFUL SUPPLY OF SOIL
 247 00:13:28:11 00:13:30:10 *IS AN ONGOING STRUGGLE.*
 248 00:13:30:12 00:13:33:11 *THE CHIEF THREAT*
IS EROSION,
 249 00:13:33:13 00:13:36:25 *WHICH CAN BE CAUSED*
BY EITHER RAIN OR WIND.
 250 00:13:36:27 00:13:40:23 THE RAIN IS A FAIRLY
 MINOR SITUATION
 HERE IN THE DESERT.
 251 00:13:40:25 00:13:43:07 WE ONLY HAVE 4 INCHES
 OF ANNUAL RAINFALL.
 252 00:13:43:09 00:13:45:23 SOMETIMES IT ALL COMES
 AT ONE TIME,
 253 00:13:45:25 00:13:49:06 AND WE DO HAVE
 SOME RUNOFF
 FROM SLOPING PARCELS
 254 00:13:49:08 00:13:51:03 OR SOME STREAM BANK
 EROSION
 255 00:13:51:05 00:13:53:00 IN STREAMS
 THAT ARE NORMALLY DRY.
 256 00:13:53:02 00:13:54:22 BUT THAT'S
 RELATIVELY MINIMAL.
 257 00:13:54:24 00:13:57:07 OUR MAJOR PROBLEM
 WITH SOIL EROSION
 RESULTS FROM THE WIND.
 258 00:13:57:09 00:14:00:16 THAT CAN HAPPEN AT
 ANY TIME OF THE YEAR--
 259 00:14:00:18 00:14:03:02 WINTER, SUMMER, FALL,
 IT DOESN'T MATTER.
 260 00:14:03:04 00:14:05:17 AND WE HAVE

261 00:14:05:19 FAIRLY HEAVY WINDS
 00:14:07:08 FOR LONG PERIODS
 OF TIME.
 262 00:14:07:10 00:14:10:15 WE HAVE TO TAKE
 A NUMBER OF PRECAUTIONS
 RELATED TO THAT.
 263 00:14:11:23 00:14:13:28 TO DISSIPATE
 THE STRONG WINDS
 264 00:14:14:00 00:14:16:27 THAT CAN REMOVE 1/2 INCH
 OR MORE OF SOIL
 265 00:14:16:29 00:14:18:12 IN A SINGLE DAY,
 266 00:14:18:14 00:14:20:26 SOPPELAND HAS PLANTED
 DENSE ROWS OF TREES,
 267 00:14:20:28 00:14:22:11 KNOWN AS WINDBREAKS,
 268 00:14:22:13 00:14:24:09 AROUND HIS FIELDS.
 269 00:14:26:03 00:14:27:16 HE'S ALSO TURNED
 270 00:14:27:18 00:14:30:01 TO THE UNITED STATES
 DEPARTMENT OF AGRICULTURE
 271 00:14:30:03 00:14:31:15 FOR ADDITIONAL IDEAS.
 272 00:14:33:12 00:14:35:10 AFTER VISITING
 SOPPELAND'S FARM
 273 00:14:35:12 00:14:38:12 AND LEARNING ABOUT
 HIS PRIMARY CONCERNS,
 274 00:14:38:14 00:14:41:02 SOIL CONSERVATIONIST
 RICK AGUAYO
 275 00:14:41:04 00:14:43:10 DREW UP
 A SOIL MANAGEMENT PLAN.
 276 00:14:47:11 00:14:49:05 THIS PLAN
 INCLUDED SUGGESTIONS
 277 00:14:49:07 00:14:52:03 ABOUT HOW FREQUENTLY
 TO PLOW THE FIELDS
 278 00:14:52:05 00:14:53:18 AS WELL AS RECOMMENDATIONS
 279 00:14:53:20 00:14:55:03 CONCERNING
 WATER MANAGEMENT
 280 00:14:55:05 00:14:56:25 AND CROP ROTATION.
 281 00:14:59:04 00:15:01:18 ALONG WITH THE USE
 OF WINDBREAKS,
 282 00:15:01:20 00:15:03:05 THESE SOIL CONSERVATION
 TECHNIQUES
 283 00:15:03:07 00:15:05:03 ARE MAKING
 A SIGNIFICANT DIFFERENCE
 284 00:15:05:05 00:15:07:03 ON WAYNE SOPPELAND'S FARM.
 285 00:15:07:05 00:15:10:10 THESE IMPROVEMENTS
 ARE NOT JUST QUICK-FIXES,
 286 00:15:10:12 00:15:11:25 BUT SUBSTANTIAL CHANGES
 287 00:15:11:27 00:15:14:09 THAT WILL KEEP
 SOPPELAND'S SOIL PRODUCTIVE
 288 00:15:14:11 00:15:16:01 FOR YEARS TO COME.
 289 00:15:18:22 00:15:21:06 WHETHER THE SPECIFIC ISSUE
 IS SOIL,
 290 00:15:21:08 00:15:23:19 MINERALS,
 OIL AND GAS, OR WATER,
 291 00:15:23:21 00:15:26:05 THERE IS
 A GROWING AWARENESS
 292 00:15:26:07 00:15:28:05 THAT MODERN CIVILIZATION
 IS RAPIDLY DEPLETING

293 00:15:28:07 00:15:30:27 *EARTH'S SUPPLY OF PRECIOUS
NATURAL RESOURCES.*
 294 00:15:33:03 00:15:37:00 *AND IT IS GEOLOGISTS
WHO ARE DEVISING NEW WAYS*
 295 00:15:37:02 00:15:38:14 *TO MORE INTELLIGENTLY*
 296 00:15:38:16 00:15:41:14 *EXTRACT AND CONSERVE
THESE RESOURCES,*
 297 00:15:41:16 00:15:43:15 *BUT THEIR ROLE EXTENDS*
 298 00:15:43:17 00:15:45:09 *WELL BEYOND THE HUNT
FOR RESOURCES.*
 299 00:15:45:11 00:15:47:25 *EARTH SCIENTISTS
ARE ALSO DEEPLY INVOLVED*
 300 00:15:47:27 00:15:51:16 *IN HELPING THE WORLD'S
POPULATION SAFELY COEXIST*
 301 00:15:51:18 00:15:54:17 *WITH THIS PLANET'S
MANY GEOLOGIC HAZARDS.*
 302 00:15:57:13 00:15:59:25 *ONE OF THE MORE
SERIOUS HAZARDS*
 303 00:15:59:27 00:16:01:25 *IN TERMS
OF POTENTIAL DESTRUCTION*
 304 00:16:01:27 00:16:03:16 *IS VOLCANIC ERUPTIONS.*
 305 00:16:03:18 00:16:08:24 *AND WHILE THERE IS NO WAY
TO ELIMINATE ERUPTIONS,*
 306 00:16:08:26 00:16:11:10 *SCIENTISTS ARE CONTINUALLY
REFINING THEIR TECHNIQUES*
 307 00:16:11:12 00:16:13:09 *FOR FORECASTING
SUCH EVENTS.*
 308 00:16:15:07 00:16:17:18 *PROBABLY
ALL VOLCANIC ERUPTIONS*
 309 00:16:17:20 00:16:19:08 *ARE PRECEDED BY*
 310 00:16:19:10 00:16:21:29 *AND ACCOMPANIED BY
MEASURABLE CHANGES*
 311 00:16:22:01 00:16:25:22 *IN THE PHYSICAL OR CHEMICAL
STATE OF THE VOLCANO.*
 312 00:16:25:24 00:16:28:06 *AND ONE
OF THE PRINCIPAL MEANS*
 313 00:16:28:08 00:16:30:08 *OF MONITORING OR MEASURING
THE CHANGES,*
 314 00:16:30:10 00:16:32:28 *AT LEAST THE PHYSICAL
CONFIGURATION OF A VOLCANO,*
 315 00:16:33:00 00:16:38:01 *IS BY MEANS OF WHAT WE CALL
GROUND DEPRIVATION STUDIES.*
 316 00:16:38:03 00:16:40:02 *THIS SIMPLY IS JUST A TERM*
 317 00:16:40:04 00:16:43:12 *FOR MEASURING THE CHANGES
IN THE SHAPE OF THE VOLCANO.*
 318 00:16:44:28 00:16:47:23 *IN A RESEARCH PROJECT
UNDERWAY IN ALASKA,*
 319 00:16:47:25 00:16:49:08 *GEOLOGISTS ARE STUDYING*
 320 00:16:49:10 00:16:51:21 *ONE OF THE MOST POWERFUL
VOLCANIC EVENTS*
 321 00:16:51:23 00:16:53:18 *OF THE 20th CENTURY--*
 322 00:16:53:20 00:16:57:13 *THE 1912 ERUPTION
OF MOUNT KATMAI.*
 323 00:16:57:15 00:16:58:25 *SCIENTISTS THERE*
 324 00:16:58:27 00:17:00:20 *BELIEVE THIS IS
AN EXCELLENT SETTING*

325 00:17:00:22 00:17:02:04 *IN WHICH TO LEARN*
326 00:17:02:06 00:17:04:20 *MORE ABOUT HOW*
EXPLOSIVE ERUPTIONS OCCUR.
327 00:17:06:07 00:17:08:21 *IT ALL HAPPENED*
IN ABOUT 60 HOURS.
328 00:17:08:23 00:17:11:23 *WE KNOW EXACTLY WHEN,*
THE DATE, THE TIME,
329 00:17:11:25 00:17:15:12 *AND ALSO--WHICH IS ALSO*
VERY UNUSUAL--
330 00:17:15:14 00:17:18:24 *IS THAT IT CAME UP*
THROUGH AN AREA
331 00:17:18:26 00:17:21:08 *WHERE NOTHING MUCH HAD*
HAPPENED VOLCANICALLY BEFORE.
332 00:17:21:10 00:17:24:08 *IT CAME UP THROUGH*
A VERY SIMPLE PART
333 00:17:24:10 00:17:25:21 *OF THE EARTH'S CRUST.*
334 00:17:25:23 00:17:28:13 *AND FINALLY, THE SYSTEM*
IS PERFECTLY PRESERVED.
335 00:17:28:15 00:17:30:27 *USUALLY IN EVENTS*
OF THIS TYPE,
336 00:17:30:29 00:17:33:27 *THERE'S AN ENORMOUS AMOUNT*
OF COLLAPSE AT THE VENT,
337 00:17:33:29 00:17:35:28 *THE AREA*
IS FLOODED BY WATER,
338 00:17:36:00 00:17:39:09 *OR IT OCCURS*
IN A VERY COMPLEX AREA,
339 00:17:39:11 00:17:41:10 *AND IT GETS ERODED AWAY.*
340 00:17:41:12 00:17:44:16 *IN THIS CASE, THE WHOLE SYSTEM*
IS PERFECTLY PRESERVED.
341 00:17:44:18 00:17:48:21 *SO THE SIZE,*
THE SIMPLICITY, GEOLOGICALLY,
342 00:17:48:23 00:17:50:06 *AND THE PRESERVATION*
343 00:17:50:08 00:17:53:03 *MAKE IT AN EXCEPTIONALLY*
GOOD PLACE
344 00:17:53:05 00:17:54:19 *TO TRY TO UNDERSTAND*
345 00:17:54:21 00:17:58:01 *THE BASIC PROCESSES*
OF EXPLOSIVE ERUPTION.
346 00:17:58:03 00:18:01:28 *ALTHOUGH MUCH DATA HAVE*
ALREADY BEEN COLLECTED,
347 00:18:02:00 00:18:06:01 *THE KATMAI PROJECT IS STILL*
IN ITS PRELIMINARY STAGES.
348 00:18:06:03 00:18:08:05 *RESEARCH MAY CONTINUE HERE*
FOR YEARS,
349 00:18:08:07 00:18:09:29 *BRINGING WITH IT*
NEW DISCOVERIES
350 00:18:10:01 00:18:13:24 *THAT WILL IMPROVE OUR*
UNDERSTANDING OF VOLCANOES.
351 00:18:15:01 00:18:15:28 [BEEPING]
352 00:18:17:22 00:18:19:15 *VOLCANIC ACTIVITY*
353 00:18:19:17 00:18:23:15 *POTENTIALLY THREATENS*
MILLIONS OF PEOPLE WORLDWIDE,
354 00:18:23:17 00:18:25:00 *BUT EQUALLY THREATENING*
355 00:18:25:02 00:18:27:16 *IS ANOTHER COMMON*
GEOLOGIC PHENOMENON--
356 00:18:27:18 00:18:29:09 *EARTHQUAKES.*
357 00:18:34:09 00:18:35:07 *AAH!*

358 00:18:35:09 00:18:36:19 [RUMBLING]
 359 00:18:40:18 00:18:42:01 [SIREN]
 360 00:18:42:03 00:18:44:01 GEOLOGISTS HAVE
 A GENERAL UNDERSTANDING
 361 00:18:44:03 00:18:46:23 OF HOW EARTHQUAKES OCCUR,
 362 00:18:46:25 00:18:49:06 AND THE AREAS MOST PRONE
 TO EARTHQUAKES
 363 00:18:49:08 00:18:51:12 HAVE ALSO BEEN IDENTIFIED.
 364 00:18:51:14 00:18:56:07 BUT MUCH REMAINS TO BE LEARNED
 ABOUT THESE EVENTS.
 365 00:18:56:09 00:18:58:15 WHILE SCIENTISTS HAVE
 SUCCESSFULLY IDENTIFIED
 366 00:18:58:17 00:19:01:06 SOME SIGNS
 OF IMPENDING EARTHQUAKES,
 367 00:19:01:08 00:19:02:29 THESE PRECURSORS
 GIVE LITTLE CLUE
 368 00:19:03:01 00:19:05:28 AS TO EXACTLY WHEN
 AN EARTHQUAKE WILL STRIKE
 369 00:19:06:00 00:19:08:14 OR HOW LARGE IT WILL BE.
 370 00:19:08:16 00:19:09:24 [SIREN]
 371 00:19:12:19 00:19:16:25 ALONG ONE PASTORAL STRETCH
 OF THE SAN ANDREAS FAULT
 372 00:19:16:27 00:19:18:24 NEAR PARKFIELD, CALIFORNIA,
 373 00:19:18:26 00:19:20:11 SCIENTISTS HOPE TO LEARN
 374 00:19:20:13 00:19:21:26 MORE ABOUT
 EARTHQUAKE PRECURSORS
 375 00:19:21:28 00:19:23:11 AND WHAT ACTUALLY HAPPENS
 376 00:19:23:13 00:19:24:29 DURING
 AN EARTHQUAKE ITSELF.
 377 00:19:28:06 00:19:32:01 GEOPHYSICISTS ARE USING A
 SOPHISTICATED ARRAY OF DEVICES
 378 00:19:32:03 00:19:35:01 TO CLOSELY MONITOR MOVEMENT
 ALONG THE FAULT.
 379 00:19:37:18 00:19:40:14 THE OBJECTIVE
 IS TO SPOT ANY CHANGES
 380 00:19:40:16 00:19:43:03 THAT MIGHT SIGNAL
 AN IMPENDING QUAKE.
 381 00:19:43:05 00:19:47:23 THE PARKFIELD EXPERIMENT
 HAS THREE GOALS.
 382 00:19:47:25 00:19:52:06 ONE GOAL IS TO TRY TO ISSUE
 A SHORT-TERM PREDICTION
 383 00:19:52:08 00:19:53:21 OF THE PARKFIELD
 EARTHQUAKE,
 384 00:19:53:23 00:19:55:06 AND THAT WOULD,
 IF SUCCESSFUL,
 385 00:19:55:08 00:19:58:06 BE THE FIRST TIME
 WE'VE EVER DONE
 SOMETHING LIKE THAT
 386 00:19:58:08 00:19:59:23 IN THIS COUNTRY.
 387 00:19:59:25 00:20:02:08 THE SECOND GOAL
 IS TO RECORD THE DETAILS
 388 00:20:02:10 00:20:03:23 OF THE EARTHQUAKE
 GENERATION PROCESS
 389 00:20:03:25 00:20:07:01 IN AS MUCH DETAIL
 AS POSSIBLE.
 390 00:20:07:03 00:20:09:01 AND THE THIRD GOAL

391 00:20:09:03 00:20:11:18 IS TO TAKE ADVANTAGE
OF A MODERATE EARTHQUAKE
392 00:20:11:20 00:20:14:18 TO RECORD
SOME OF THE EFFECTS
OF THE EARTHQUAKE,
393 00:20:14:20 00:20:17:02 SUCH AS THE AMOUNT
OF SHAKING THAT OCCUR
394 00:20:17:04 00:20:20:00 AT DIFFERENT DISTANCES
FROM THE FAULT.
395 00:20:20:02 00:20:21:22 *WHILE EARTHQUAKE PREDICTION*
396 00:20:21:24 00:20:23:22 *IS A SIGNIFICANT GOAL*
FOR GEOLOGISTS,
397 00:20:23:24 00:20:26:27 *MOST STRESS*
THAT EARTHQUAKE PREPARATION
398 00:20:26:29 00:20:28:12 *IS EVEN MORE IMPORTANT.*
399 00:20:29:29 00:20:31:11 FIRST OF ALL,
400 00:20:31:13 00:20:35:09 WE MUST TRY TO SHORE UP
EXISTING STRUCTURES
401 00:20:35:11 00:20:37:20 AND MAKE THEM
MORE EARTHQUAKE-RESISTANT.
402 00:20:37:22 00:20:42:05 THERE IS NO SUCH THING AS AN
EARTHQUAKE-PROOF STRUCTURE,
403 00:20:42:07 00:20:44:19 NOT AT LEAST
AN ECONOMICALLY BUILT ONE.
404 00:20:44:21 00:20:47:01 BUT WE CAN MAKE THINGS
EARTHQUAKE-RESISTANT
405 00:20:47:03 00:20:50:00 SO THAT LOSS OF LIFE
IS MINIMAL,
406 00:20:50:02 00:20:52:04 MAYBE ZERO LOSS OF LIFE.
407 00:20:52:06 00:20:54:14 THAT CAN BE DONE NOW
AND SHOULD BE.
408 00:20:54:16 00:20:56:00 IT'S EXPENSIVE,
409 00:20:56:02 00:21:00:04 BUT WE MUST RESTRENGTHEN OLD
BUILDINGS, OLD STRUCTURES.
410 00:21:00:06 00:21:02:23 FURTHERMORE,
WE HAVE LAWS ON THE BOOKS
411 00:21:02:25 00:21:06:02 THAT PREVENT BUILDING
NEW STRUCTURES
412 00:21:06:04 00:21:07:16 IN EARTHQUAKE-PRONE AREAS
413 00:21:07:18 00:21:09:21 WHERE THE DANGERS
ARE EXCESSIVE.
414 00:21:09:23 00:21:12:08 THOSE LAWS
SHOULD BE MAINTAINED
415 00:21:12:10 00:21:13:27 AND PERHAPS
EVEN STRENGTHENED.
416 00:21:13:29 00:21:15:26 WE HAVE ALSO BUILDING CODES
417 00:21:15:28 00:21:17:11 THAT REQUIRE
MODERN BUILDINGS
418 00:21:17:13 00:21:19:26 TO BE BUILT SUFFICIENT
TO WITHSTAND
419 00:21:19:28 00:21:22:12 INTENSE GROUND SHAKING.
420 00:21:22:14 00:21:27:19 CONTINUED RESEARCH INTO BUILDING
STRUCTURES OF ALL SORTS
421 00:21:27:21 00:21:29:07 AND THEIR RESISTIVITY
TO EARTHQUAKES
422 00:21:29:09 00:21:30:18 MUST GO FORWARD.

423 00:21:30:20 00:21:32:19 THAT'S SOMETHING
WE CAN DO NOW.

424 00:21:32:21 00:21:34:03 WE DON'T NEED TO KNOW

425 00:21:34:05 00:21:36:03 WHEN THE NEXT EARTHQUAKE
IS COMING

426 00:21:36:05 00:21:39:00 TO KNOW IT'S IMPORTANT TO
BUILD BUILDINGS THAT STAY UP

427 00:21:39:02 00:21:41:21 AND DON'T LOSE WINDOWS
AND FACING MATERIAL

428 00:21:41:23 00:21:43:20 IN THE EVENT
OF AN EARTHQUAKE.

429 00:21:43:22 00:21:45:13 [RUMBLING]

430 00:21:45:15 00:21:48:02 *EVEN MORE DESTRUCTIVE THAN
VOLCANOES AND EARTHQUAKES*

431 00:21:48:04 00:21:50:02 *ARE MUD FLOWS,
LANDSLIDES,*

432 00:21:50:04 00:21:52:16 *AND OTHER RELATED
EARTH MOVEMENTS.*

433 00:21:54:20 00:21:57:18 *EVERY YEAR, THEY EXACT
A STAGGERING TOLL*

434 00:21:57:20 00:21:59:21 *ON POPULATED AREAS.*

435 00:21:59:23 00:22:01:08 *IN SOME PLACES,*

436 00:22:01:10 00:22:04:05 *PEOPLE HAVE ATTEMPTED TO
LIVE WITH LAND MOVEMENTS,*

437 00:22:04:07 00:22:06:29 *ALTHOUGH NOT ALWAYS
VERY SUCCESSFULLY.*

438 00:22:08:27 00:22:10:24 *WHEN NEW CONSTRUCTION
IS PLANNED*

439 00:22:10:26 00:22:12:29 *FOR AREAS WITH SLOPES,*

440 00:22:13:01 00:22:14:29 *GEOLOGISTS ARE OFTEN
CALLED UPON*

441 00:22:15:01 00:22:17:13 *TO EVALUATE
POTENTIAL LANDSLIDE RISK.*

442 00:22:17:15 00:22:20:06 WHERE ARE WE? YOU
GOT YOUR COMPASS?

443 00:22:20:08 00:22:22:21 IT'S GOT THE LIMITS
OF THE SLIDE HERE.

444 00:22:22:23 00:22:25:19 *FIRST, THE PROPOSED
BUILDING SITE IS MAPPED.*

445 00:22:25:21 00:22:27:06 *NEXT, DRILLING IS DONE*

446 00:22:27:08 00:22:30:06 *TO GIVE THE GEOLOGISTS
A DIRECT VIEW*

447 00:22:30:08 00:22:33:21 *OF THE SUBSURFACE STRUCTURE
AT THE SITE.*

448 00:22:33:23 00:22:35:05 *ALONG WITH SOIL SAMPLES*

449 00:22:35:07 00:22:36:27 *OBTAINED DURING
THE DRILLING PROCESS,*

450 00:22:36:29 00:22:38:27 *THIS PROVIDES
MUCH-NEEDED DATA*

451 00:22:38:29 00:22:43:01 *ABOUT THE HISTORY OF LANDSLIDE
ACTIVITY IN THE AREA.*

452 00:22:44:28 00:22:48:14 AS WE DRILL THE HOLE
IN THAT AREA,

453 00:22:48:16 00:22:50:12 WE'LL BE SAMPLING
THE MATERIAL

454 00:22:50:14 00:22:53:22 TO DETERMINE

455 00:22:53:24 HOW STRONG IT IS.
00:22:55:25 WE WILL ALSO
BE DESCRIBING IT
456 00:22:55:27 00:22:58:26 IN TERMS OF ITS
SOIL CHARACTERISTICS,
457 00:22:58:28 00:23:02:02 SUCH AS GRAIN SIZE,
MOISTURE, COLOR,
458 00:23:02:04 00:23:04:04 AND VARIETY OF TYPES
OF CHARACTERISTICS
459 00:23:04:06 00:23:07:25 WHICH WILL BE USEFUL
TO THE ENGINEERS
IN THE OFFICE
460 00:23:07:27 00:23:09:25 WHEN THEY DETERMINE
WHETHER OR NOT
461 00:23:09:27 00:23:13:10 THE MATERIAL
WILL BE SUITABLE
TO STAND IN A SLOPE
462 00:23:13:12 00:23:16:07 OR TO BE REUSED AS FILL
SOMEWHERE ELSE
ON THE SITE.
463 00:23:16:09 00:23:19:07 ONCE WE'VE WORKED
WITH OUR ENGINEERS
IN THE OFFICE
464 00:23:19:09 00:23:22:29 AND DETERMINED WHETHER
THE SLOPES PROPOSED
WILL BE STABLE,
465 00:23:23:01 00:23:25:19 WHAT TYPE OF REMOVALS
ARE NECESSARY,
466 00:23:25:21 00:23:28:18 WE'LL PREPARE
A REPORT WITH
ALL THIS INFORMATION
467 00:23:28:20 00:23:31:23 THAT WE CAN THEN SHARE
WITH THE CLIENT.
468 00:23:31:25 00:23:35:06 *AFTER EVALUATING
THE STABILITY OF A SITE,*
469 00:23:35:08 00:23:36:23 *GEOLOGISTS CAN MAKE
RECOMMENDATIONS*
470 00:23:36:25 00:23:38:23 *ABOUT WHETHER
A BUILDING PROJECT*
471 00:23:38:25 00:23:40:11 *SHOULD BE UNDERTAKEN.*
472 00:23:42:20 00:23:45:18 *ULTIMATELY, THIS CAN
HELP MINIMIZE THE RISK*
473 00:23:45:20 00:23:48:16 *OF DEATH AND DESTRUCTION
DUE TO LANDSLIDE ACTIVITY.*
474 00:23:50:09 00:23:52:07 THE HUMAN POPULATION
OF THIS PLANET
475 00:23:52:09 00:23:54:05 IS NOW CLOSE
TO SIX BILLION,
476 00:23:54:07 00:23:55:20 AND IT'S INCREASING
EXPONENTIALLY.
477 00:23:55:22 00:23:57:20 MANY OF THE WORLD'S
POPULATION CENTERS
478 00:23:57:22 00:24:01:24 ARE LOCATED IN AREAS
THREATENED BY NATURAL
GEOLOGIC HAZARDS,
479 00:24:01:26 00:24:03:24 SUCH AS EARTHQUAKES,

480 00:24:03:26 VOLCANIC ERUPTIONS,
 481 00:24:05:11 00:24:05:09 AND LANDSLIDES.
 482 00:24:07:26 00:24:07:24 GEOLOGISTS ARE WORKING TO
 UNDERSTAND THE EXACT NATURE
 483 00:24:10:12 00:24:10:10 OF HAZARDOUS GEOLOGIC
 PROCESSES LIKE THESE,
 484 00:24:12:10 00:24:12:08 AND THEN APPLYING
 THIS KNOWLEDGE
 485 00:24:14:29 00:24:14:27 TO REDUCE THE TOLL
 ON HUMAN LIFE.
 486 00:24:16:14 00:24:16:12 THE TEEMING
 INDUSTRIALIZED SOCIETIES
 487 00:24:19:14 00:24:19:12 THAT HAVE RESULTED FROM
 THIS POPULATION EXPLOSION
 488 00:24:22:03 00:24:22:01 HAVE ALSO SPAWNED
 ENVIRONMENTAL PROBLEMS,
 489 00:24:24:03 00:24:24:01 WHICH ARE ONLY NOW
 BEING RECOGNIZED.
 490 00:24:27:03 00:24:27:01 GEOLOGISTS ARE ACTIVELY
 INVOLVED IN THE BATTLE
 491 00:24:29:20 00:24:29:18 TO OVERCOME A BROAD RANGE
 OF THESE PROBLEMS.
 492 00:24:33:02 00:24:33:00 AS THE WORLD'S POPULATION
 CONTINUES TO GROW,
 493 00:24:36:17 00:24:36:15 THE ENVIRONMENTAL CHALLENGE
 LOOMS EVER LARGER,
 494 00:24:42:14 00:24:42:13 AND THE STAKES
 GROW EVEN HIGHER.
 495 00:24:43:25 00:24:43:23 *TODAY'S EARTH SCIENTIST*
 496 00:24:46:13 00:24:46:11 *IS EXPECTED TO PLAY*
A DUAL ROLE--
 497 00:24:48:26 00:24:48:24 *HELPING TO LOCATE*
VALUABLE NATURAL RESOURCES,
 498 00:24:50:18 00:24:50:16 *WHILE AT THE SAME TIME,*
 499 00:24:52:03 00:24:52:01 *PROTECTING THE ENVIRONMENT*
 500 00:24:56:26 00:24:55:00 *WHICH PROVIDES THOSE RESOURCES*
IN THE FIRST PLACE.
 501 00:24:59:22 00:24:59:20 GEOLOGISTS AND EARTH
 SCIENTISTS IN GENERAL
 502 00:25:01:17 00:25:01:15 ARE THE SCIENTISTS
 WHO ARE CAPABLE
 503 00:25:06:01 00:25:06:01 OF DEALING WITH THE PROBLEMS
 504 00:25:08:25 00:25:08:23 OF RESOURCE EXTRACTION
 505 00:25:12:19 00:25:12:17 AND ENVIRONMENTAL
 PROTECTION.
 506 00:25:16:24 00:25:16:22 WE THEREFORE HAVE A DUAL
 OBLIGATION TO SOCIETY--
 507 00:25:19:00 00:25:18:28 TO MAINTAIN OUR...
 508 00:25:22:21 00:25:22:19 OUR MATERIAL BASE
 509 00:25:27:02 00:25:27:00 BY PROVIDING THE RESOURCES
 TO THE POPULACE
 510 00:25:30:00 00:25:29:28 AND BY MAINTAINING
 SOME CONTROL
 511 00:25:31:29 00:25:31:27 OVER ENVIRONMENTAL
 DEGRADATION.
 00:25:34:11 WE CAN'T HAVE IT BOTH WAYS.

512 00:25:34:13 00:25:37:02 EVERY TIME
 WE MODIFY THE ENVIRONMENT,
 513 00:25:37:04 00:25:40:06 TO SOME EXTENT,
 IT IS DEGRADED.
 514 00:25:40:08 00:25:41:21 WE CAN'T MAKE IT BETTER,
 515 00:25:41:23 00:25:44:21 NO MATTER WHAT
 SOME OF THE ADS MAY SAY.
 516 00:25:44:23 00:25:46:21 SO WE'VE GOT TO BE CERTAIN
 517 00:25:46:23 00:25:49:05 THAT WE USE OUR RESOURCES
 AS WISELY AS POSSIBLE.
 518 00:25:49:07 00:25:52:15 EARTH SCIENTISTS KNOW
 THE NATURE OF THE RESOURCES,
 519 00:25:52:17 00:25:54:01 WHERE THEY'RE LOCATED,
 520 00:25:54:03 00:25:55:23 WHAT THEIR OCCURRENCE IS,
 521 00:25:55:25 00:25:57:22 HOW WE CAN EXTRACT THEM
 EFFICIENTLY.
 522 00:25:57:24 00:26:00:16 THAT MUST BE AN IMPORTANT GOAL
 FOR THE FUTURE--
 523 00:26:00:18 00:26:03:00 TO MAKE CERTAIN
 THAT WE USE OUR RESOURCES
 524 00:26:03:02 00:26:06:07 AS EFFICIENTLY
 AND EFFECTIVELY AS POSSIBLE,
 525 00:26:06:09 00:26:09:04 WITH AS LITTLE WASTE
 AS POSSIBLE
 526 00:26:09:06 00:26:10:25 FOR FUTURE GENERATIONS.
 527 00:26:13:11 00:26:15:09 *WHETHER THE RESOURCE*
IN QUESTION
 528 00:26:15:11 00:26:18:29 *IS FOSSIL FUEL, SOIL,*
OR GROUND WATER,
 529 00:26:19:01 00:26:22:10 *GEOLOGISTS ARE CHARGED WITH*
A UNIQUE RESPONSIBILITY...
 530 00:26:23:27 00:26:26:24 *PROVIDING THE PUBLIC*
WITH A FUNDAMENTAL AWARENESS
 531 00:26:26:26 00:26:29:18 *OF HOW PLANET EARTH*
FUNCTIONS.
 532 00:26:34:15 00:26:36:27 PERHAPS MORE
 THAN ANY OTHER SCIENCE,
 533 00:26:36:29 00:26:39:28 GEOLOGY HAS INFLUENCED
 THE EVOLUTION OF CIVILIZATION
 534 00:26:40:00 00:26:41:12 AND THE HISTORY OF NATIONS.
 535 00:26:41:14 00:26:43:29 NATURAL GEOLOGIC HAZARDS
 HAVE DEVASTATED CITIES
 536 00:26:44:01 00:26:47:20 AND CONTRIBUTED
 TO THE FALL OF GOVERNMENTS.
 537 00:26:47:22 00:26:50:14 THE GEOGRAPHIC DISTRIBUTION
 OF FOSSIL FUELS,
 538 00:26:50:16 00:26:53:19 PRECIOUS METALS AND GEMS,
 AND INDUSTRIAL MINERALS
 539 00:26:53:21 00:26:56:05 HAVE CREATED EMPIRES
 AND CAUSED WARS.
 540 00:26:56:07 00:26:59:06 IT HAS ALLOWED THE CITIZENS
 OF SOME NATIONS
 541 00:26:59:08 00:27:00:21 TO ENJOY BOUNDLESS
 PROSPERITY,
 542 00:27:00:23 00:27:03:06 WHILE THOSE LIVING
 IN LESS FORTUNATE REGIONS

543 00:27:03:08 00:27:06:11 STRUGGLE TO EKE OUT
A MARGINAL EXISTENCE.
544 00:27:06:13 00:27:09:26 BUT GEOLOGY HAS GIVEN US
MORE THAN OIL AND METALS
545 00:27:09:28 00:27:11:25 AND PREDICTIONS
OF NATURAL DISASTERS.
546 00:27:11:27 00:27:13:26 THE SCIENCE OF GEOLOGY
WAS FOUNDED,
547 00:27:13:28 00:27:15:10 NOT FOR ECONOMIC BENEFIT,
548 00:27:15:12 00:27:17:25 BUT FROM HUMAN CURIOSITY
ABOUT THE EARTH,
549 00:27:17:27 00:27:19:12 AND IT'S PROVIDED US
550 00:27:19:14 00:27:23:00 WITH A WAY TO UNDERSTAND
THIS PLANET WE CALL HOME.
551 00:27:23:02 00:27:25:00 GEOLOGISTS
RARELY CONDUCT EXPERIMENTS.
552 00:27:25:02 00:27:27:16 IT'S NOT POSSIBLE
TO CAREFULLY CONTROL
553 00:27:27:18 00:27:30:24 THE GEOLOGIC CONDITIONS
IN THIS GLOBAL LABORATORY.
554 00:27:30:26 00:27:33:08 INSTEAD, WORKING FROM
THE SHREDS OF EVIDENCE
555 00:27:33:10 00:27:35:22 THAT HAVE ESCAPED EROSION
AND DESTRUCTION
556 00:27:35:24 00:27:37:07 BY GEOLOGIC PROCESSES,
557 00:27:37:09 00:27:38:22 GEOLOGISTS HAVE
PIECED TOGETHER
558 00:27:38:24 00:27:42:01 THE DETAILS OF EARTH'S
FUNCTION AND HISTORY.
559 00:27:42:03 00:27:44:02 THE IMAGE OF EARTH
FROM SPACE
560 00:27:44:04 00:27:48:01 IS A KIND OF VISUAL METAPHOR
FOR THE SCIENCE OF GEOLOGY.
561 00:27:48:03 00:27:51:14 FROM SPACE, WE CAN PERCEIVE
ONLY THE DIMMEST OF CLUES
562 00:27:51:16 00:27:54:14 ABOUT THE PLANET LYING
BENEATH THE SWIRLING CLOUDS
563 00:27:54:16 00:27:55:29 AND DEEP BLUE OCEANS.
564 00:27:56:01 00:27:57:13 TO UNLOCK THE MYSTERIES
565 00:27:57:15 00:27:59:14 OF OUR COMPLEX
AND BEAUTIFUL PLANET
566 00:27:59:16 00:28:01:15 AND TO UNDERSTAND
ITS SIGNIFICANCE
567 00:28:01:17 00:28:03:00 TO OUR OWN LIVES,
568 00:28:03:02 00:28:05:29 WE MUST CAREFULLY EXAMINE
THE PROCESSES AND PRODUCTS
569 00:28:06:01 00:28:07:14 OF GEOLOGIC ACTIVITY.
570 00:28:07:16 00:28:09:28 AND DURING THE COURSE
OF *EARTH REVEALED*,
571 00:28:10:00 00:28:13:04 THAT'S EXACTLY
WHAT WE PROPOSE TO DO.
572 00:28:15:17 00:28:18:16 CAPTIONING MADE POSSIBLE BY
SOUTHERN CALIFORNIA CONSORTIUM
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