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April 5, 1986

M E M O R A N D U M

TO: Dae Chung, L-196
Lawrence Livermore National Laboratory
P.O. Box 808
Livermore, CA 94550

FROM: Burt Slemmons

This is an informal note to enclose a partial draft proposal for a remote sensing--low-sun angle aerial photography study of the Yakima Fold Belt. This will include the Toppenish Ridge--southwestern Columbia Plateau region. I believe that this research program that would take about 6 months to complete. I will discuss this project tomorrow with Larry McKague and can discuss this further with you later this week by telephone. The ultimate purpose is to establish possible maximum earthquakes for various active faults and seismogenic folds of the Yakima Fold Belt.

Harold:

This was a very sketchy proposal that does not discuss the possible change in design EQ magnitudes. Dae checked on possibility of funding and possible reorganization this June. He indicated that we could submit later this summer

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April 5, 1986

TO: Dae Chung, L-196
Lawrence Livermore National Laboratory
P.O. Box 808
Livermore, CA 94550

FROM: Burt Slemmons

SUBJECT: Remote Sensing Analysis of Yakima Fold Belt structures, Columbia Plateau.

I recommend that you urge NRC to authorize and start special remote sensing assessments of faults and folds of the Yakima Fold Belt, Washington. These studies are needed for the assessment of the seismotectonic setting at Hanford.

Need for Project:

Several factors show the need for the following remote sensing study.

In 1981 Campbell and Bentley (Appendix A) recognized late Quaternary scarps along a crestal graben, a hinge fault, and a fan set along the Mill Creek thrust fault at the northern edge of the Toppenish Ridge anticline in the Yakima Fold Belt. They measured scarp heights of up to 4 meters and a belt of scarps in a zone of 32 km length. Slemmons (1982) in NUREG-0892, Supplement No. 1 showed that if the scarps were seismogenic and

were formed during one earthquake, the Ms magnitude was 7.4 with a standard deviation of 0.3. This suggests a potential for great earthquakes in the Yakima Fold Belt.

The El Asnam earthquake in Algeria was associated with similar fault scarps, grabens, and anticlinal co-seismic folding along the main anticline. The faults were also distributed over a length of 32 km and the maximum offset was about 3 m. I visited the El Asnam area in 1984 and was impressed with the many similarities between the two geologic structures. Lloyd Cluff, and geologists from Woodward-Clyde Consultants examined both areas and they also believe that the scarps at Toppenish Ridge may be tectonic and coseismic.

During the past two or three years it has been recognized that the surface expression of tectonic and seismic events may be by folding, or combinations of faulting and folding. These relations appear to be especially well expressed in compressional tectonic regions like those of the El Asnam (Algeria), Tobas-E-Golshan (Iran) and Coalinga (California) earthquake areas. These may also make segmentation difficult to recognize.

Recently used techniques, including several remote sensing methods, and expanded experience in compressional tectonic regimes suggest the need to reexamine Yakima Fold Belt with existing and selected new images. Some of the methods are described in Appendix B, from Slemmons (1981) . Most of the

major structures of the Yakima Fold Belt have already been photographed using low-sun angle (LSA) aerial photographs, but some essential parts of the region have not been photographed using these techniques. LSA imagery has not been obtained for Toppenish Ridge and active faults between the western end of Toppenish Ridge and the Columbia River. Aerial reconnaissance of the main structures suggests that imagery analysis is needed to verify tectonic activity, assist in characterizing active faults and determine interrelationships of faults and folds.

The recent abstract of Anderson and Tolan (1986), as reproducted in Appendix C, strongly suggests that the tectonic activity of Toppenish Ridge is interconnected with contemporaneous wrench faulting of the Maupin, Laurel, Luna Butte and Arlington faults. Their oral presentation at the Cordilleran Meeting of the Geological Society of America shows late Quaternary faulting and such major geomorphic and structural features as brachydomes, similar to that observed along the Newport-Inglewood fault zone. These Southwest Columbia Plateau structures need to be evaluated and correlated with Yakima Fold Belt anticlines using LSA and other imagery methods of analysis.

Method of Analysis:

Previous regional fault and lineament studies have been prepared for WPPS and Rockwell Hanford Operations. The "multi" approach described by Slemmons (1981) will be used, by reviewing previous studies, reexamining the 1:12,000 available LSA aerial

photographs in the Yakima Fold Belt and adding LSA aerial photography for geologic structures between Toppenish Ridge and the Columbia River. The products will include 1:62,500 or 1:250,000 scale quadrangle maps with annotations on fault and fold features. The maps will be accompanied by a report that will be based on a remote analysis of remotely sensed data on Quaternary activity of fault-related features. Recommendations will be made for specific field areas that are suitable for further study.

References

Anderson, J. L, and Tolan, T. L., 1986, Ages of wrench faulting in interridge basins, southwest Columbia Plateau, Washington and Oregon: Geological Society of America, Abstracts with Programs, v. 18, n. 2, p. 82.

Campbell, N. P., and R. D. Bentley, 1981, Late Quaternary deformation of the Toppenish Ridge uplift in south-central Washington: Geology, v. 9, p. 519-524.

Slemmons, D. B., 1981, A procedure for analyzing fault-controlled lineaments and the activity of faults: in O'Leary, D. W., and Earle, J. L., eds., Proceedings of the Third International Conference on Basement Tectonics, n. 3, p. 33-49.

Proposed Budget:

Personnel

D. B. Slemmons

LLNL Staff?

Geomorphologist-Structural Geologist

Supplies and Materials

Low-Sun Angle (LSA) Aerial Photographs, 800 photographs, estimated at @$12 each.	$9,200
Available Regular and LSA Aerial Photographs, 2,000 photographs, estimated at $3 each.	6,000

Field Expenses

Travel, airline and rental car	1,000
Per Diem, 20 days @$75/day for two workers	1,000
10 Percent Handling Charge for Supplies and Materials and Field Expenses	1,700p