DEPARTMENT OF THE INTERIOR

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Computer Graphics: Minicomputer results from a micro

Arnold F. Theisen [1/]

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[1/] Flagstaff, Arizona

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ABSTRACT

Computer graphics play a key role in the analysis of visible and near-infrared excitation-emission spectra of luminescent natural and man-made materials. Until now, high-quality 3-D perspective plots of these spectra were available only through the use of costly time-shared minicomputers. Significant time and money have been saved by modifying commercial 3-D software for an Apple microcomputer and a Houston Instruments plotter.

INTRODUCTION

Our luminescence studies involve the systematic cataloging and analysis of the spectral properties of rocks, minerals, and other natural and man-made materials so that data from luminescence remote-sensing devices can be evaluated with greater specificity (Hemphill, Theisen, and Tyson, 1984). A fluorescence spectrometer, modified and integrated with a personal computer, is used to produce spectral data that are combined with chemical and mineralogical information to determine the probable physical and/or chemical causes of the luminescence of these materials (Theisen and Hemphill, 1985). Software, written in-house, guides the acquisition of data, provides for the manipulation of those data, and displays them in several different forms.

For the analysis of the visible and near-visible excitation and emission properties, a data array is produced by repeatedly scanning the emission monochrometer with luminescence intensity read at 5 or 10 nanometer intervals and with the excitation monochrometer stepped at the same intervals. In addition, luminescence is measured with the emission monochrometer set at the wavelengths of various Fraunhofer lines to assess whether the intensity is within the sensitivity limits of the Fraunhofer line discriminator (an airborne electro-optical device for detecting and/or imaging materials that have been stimulated to luminesce by the Sun; Watson and Hemphill, 1976).

GRAPHICS

Computer graphics play a key role in the analysis of the luminescence spectra of rocks, minerals, and other natural and man-made materials. Visible and near-visible excitation and emission spectra are generated and stored by using a Perkin-Elmer fluorescence spectrometer interfaced to an Apple II+ computer (Theisen and Hemphill, 1985). Much time and effort has been spent to acquire the most reliable spectra possible from our existing, sometimes cantankerous, laboratory equipment. Therefore these data deserve to be displayed with the best computer graphics techniques available.

The first software we used to present our data in 3-D perspective format was a highly sophisticated package from California Computer Products, Inc. (CalComp) run on a Digital Equipment Corporation PDP-11/15. The plots done on a CalComp plotter were excellent (figure 1), displaying the data in an unambiguous fashion and revealing some stray-light problems with the spectrometer that we had not previously suspected. Unfortunately, due to data preparation and slow turn-around times on the multiuser system, the cost was too great to do more than a few samples.

The next software used was the A2-3D2 Graphics Package from SubLogic Corporation. This software runs on Apple II systems and, as written, displays a 3-D perspective plot on a monitor or provides an output file. There is no provision to remove lines that should be hidden from view. Therefore, this software was originally used to take a "first look" at the excitation-emission spectra. If they were of sufficient interest, a plot was produced with the CalComp plotter. Although Apple screen dumps were made (figure 2), software to enlarge these displays merely enlarges the dot size. Software was written in-house to take advantage of the A2-3D2 output file to plot an enlarged version with a dot-matrix printer. This intermediate step provided an opportunity to include a hidden-line-removal algorithm (Myers, 1982) in the plotting process directly from the Apple (figure 3). The product was improved further when a Houston Instruments DMP-29 plotter was purchased. Near-vertical lines could now be seen as true lines rather than dots (figure 4). Even though all the above techniques provided a usable picture, production of the hardcopy was very slow with the Apple. Enhancement Technology came to the rescue, as they manufacture a co-processor that plugs into an expansion slot in the Apple. The Enhancement Technology PDQ features a Motorola 68000 microprocessor running at 10 megahertz and 256 kilobytes of memory. The major advantage of this particular co-processor is that unaltered Applesoft BASIC programs run at increased speed. With the BASIC compiler now available, programs run at 68000 machine language speeds. Excitation-emission spectra such as shown by figure 4 can now be plotted in approximately 20 minutes instead of the 3 hours required when using the Apple alone. By comparison, a CalComp plot takes 15 minutes from a control tape created with CalComp software.

One problem still remained: the output file had the same spatial resolution as is used by the Apple screen display. To approach the quality of the CalComp, much greater resolution is required. With point precision up to 0.001 in, the DMP-29 is capable of reproducing the desired resolution. We learned from SubLogic that the A2-3D2 software has not been improved to increase the resolution of its output file since we purchased it in February 1983. An intense investigation of the machine language 3-D software revealed that greater resolution was available within the program but was being discarded. We made changes to bring this resolution out of the machine language program and to make it accessible to the BASIC plotting program. We applied appropriate scaling to the resulting numbers and made a high-resolution plot (figure 5). The new high-resolution plot generated with the enhanced Apple is of equal quality to the plot made with the CalComp. Now, publication-quality products can be made in-house saving both time and money.

REFERENCES

Hemphill, W.R., Theisen, A.F., and Tyson, R.M., 1984, Laboratory analysis and airborne detection of materials stimulated to luminesce by the Sun: in the Journal of Luminescence, Elsevier Science Publishers B.V., Amsterdam, Holland, p. 724-726.

Myers, R.E., 1982, Microcomputer graphics: Reading, Mass., Addison-Wesley Publishing Company, 282 p.

Theisen, A.F., and Hemphill, W.R., 1985, Microcomputers in the luminescence laboratory: A technique for automating spectrometers: American Laboratory, v. 17, no. 9, p. 166-171.

Watson, R.D., and Hemphill, W.R., 1976, Use of an airborne Fraunhofer line discriminator for the detection of solar-stimulated luminescence: U.S. Geological Survey Open-File Report 76-202, 110 p.

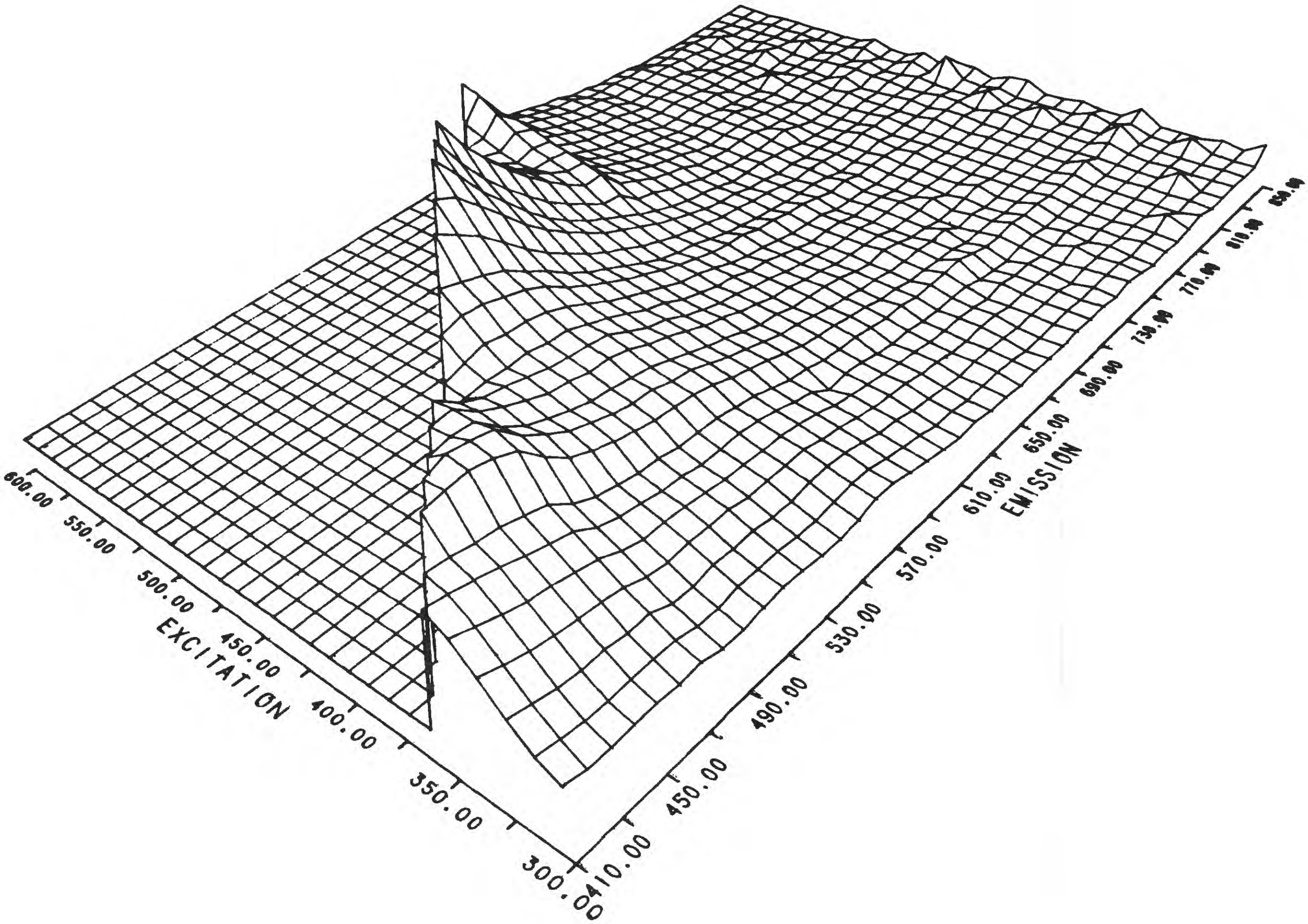
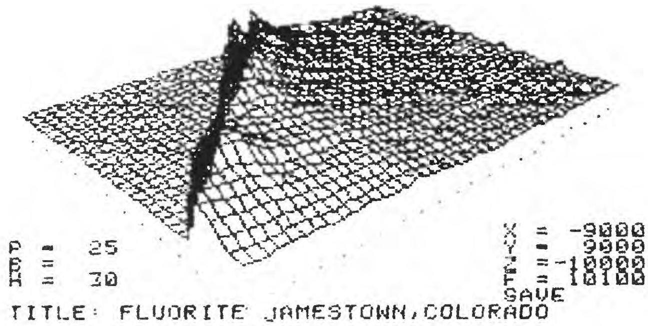


Figure 1. CalComp plot of 3-D perspective view of excitation-emission spectra for fluorite from Jamestown, Colorado.



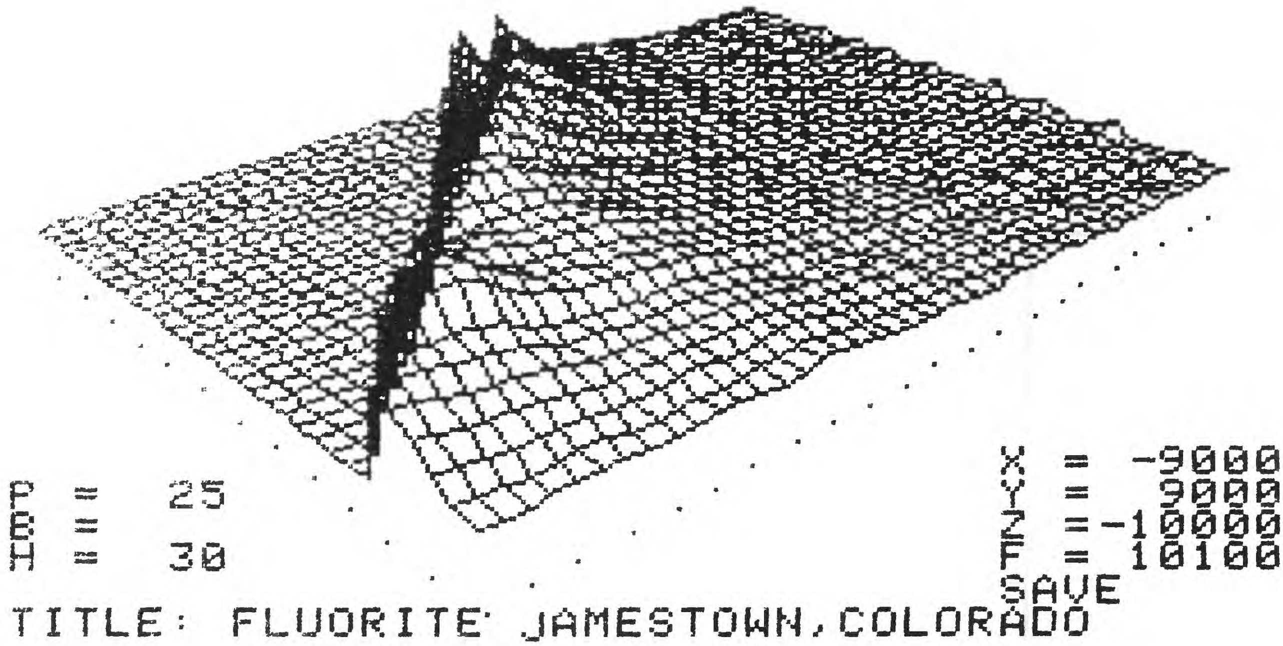


Figure 2. Apple II screen dump of excitation-emission spectra for fluorite. SubLogic A2-3D2 software was used.

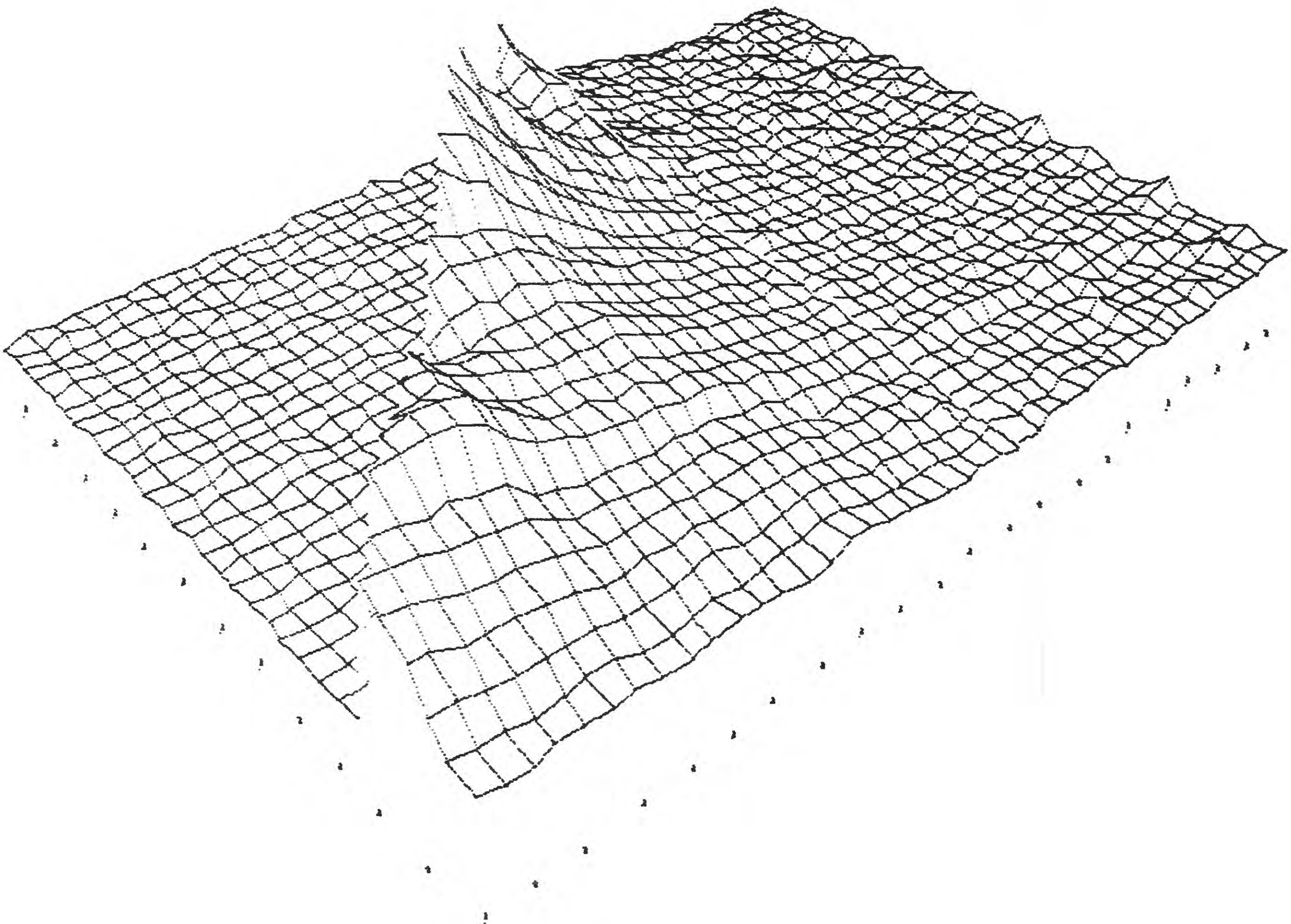


Figure 3. Dot-matrix plot of excitation-emission spectra for fluorite. Hidden-line-removal algorithm was used.

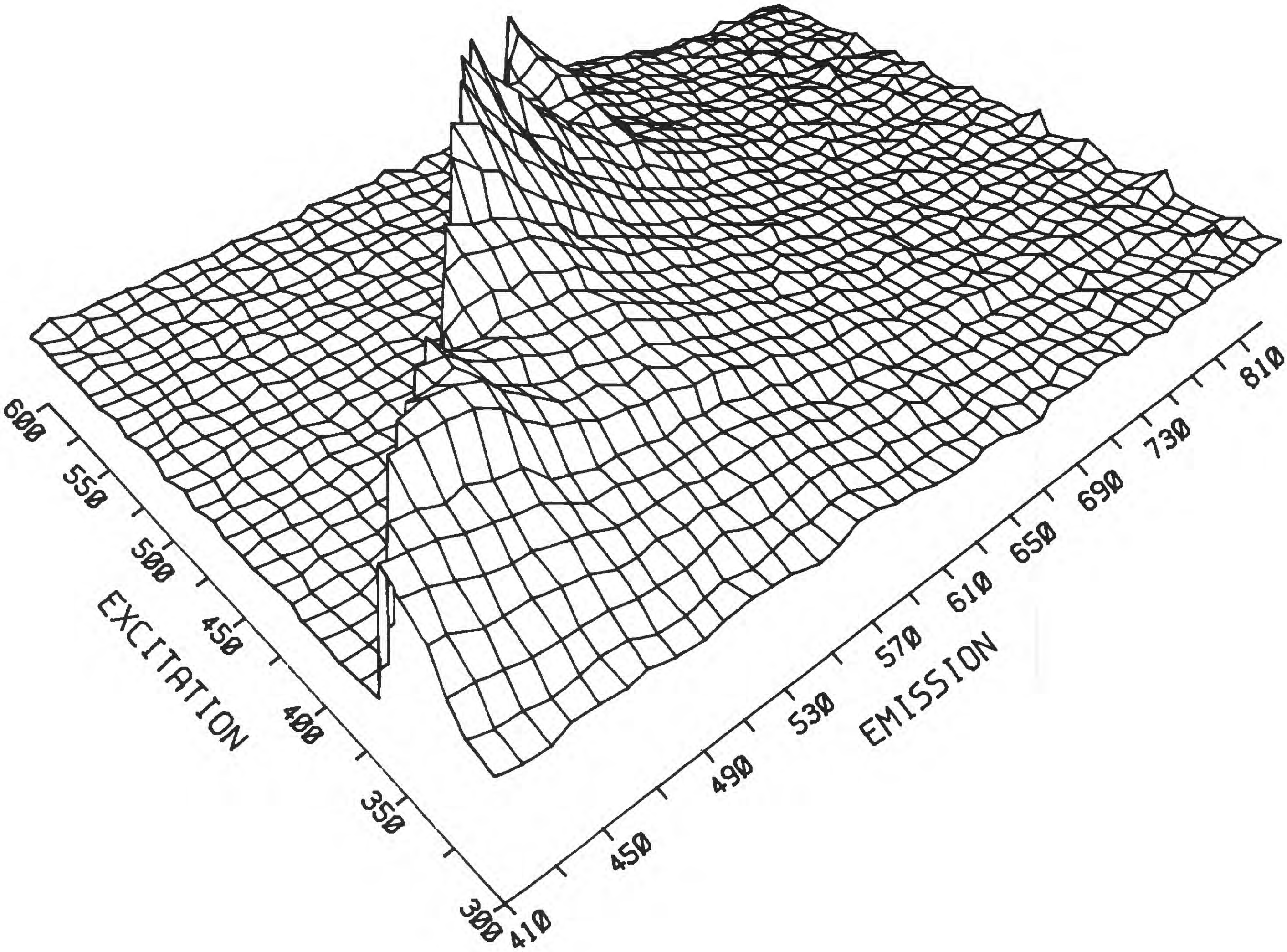


Figure 4. Houston Instruments DMP-29 plot of excitation-emission spectra for fluorite.

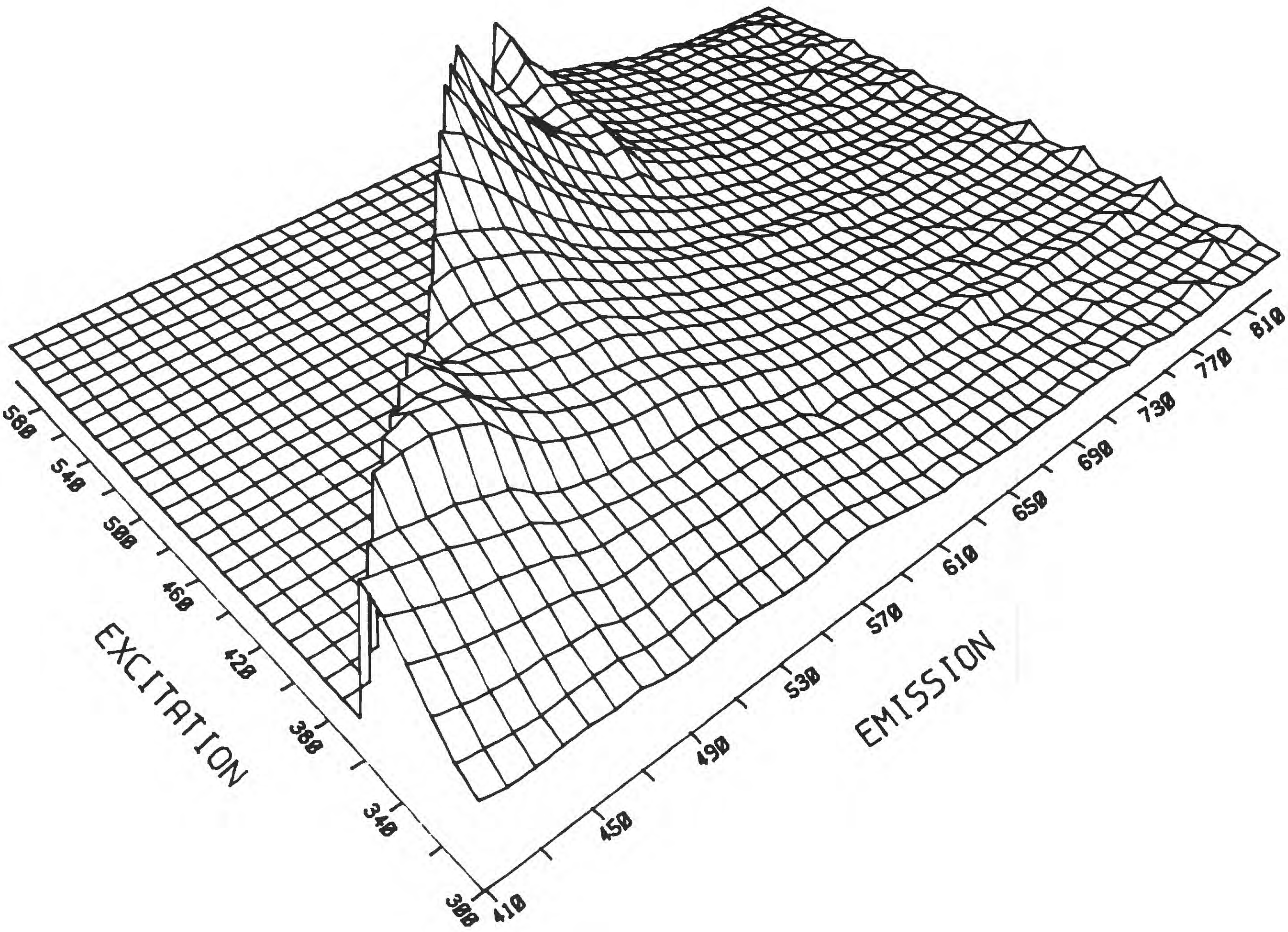


Figure 5. Excitation-emission plot made with A2-3D2 program modified for high resolution output.