

**AERI data report No. 3**

(The following is a letter summary report)

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April 28, 1993

Dr. Robert Ellingson,  
Department Of Meteorology  
University of Maryland  
RE: AERI Data for SPECTRE

Dear Bob,

As the SPECTRE project nears completion here at the UW, let me summarize the activities that have been completed and those that will be completed in the near future.

The main activity of this final year of the three year project has revolved around the "re-calibration" of the data from the Atmospheric Emitted Radiance Interferometer (AERI) prototype collection at Coffeyville, KS during the SPECTRE field phase. As you know, this activity has overlapped in time with the preparation of the hardware and software system for deployment to the Southern Great Plains CART site. A considerable synergism has developed between the two programs with analysis of ARM data collected at SPECTRE influencing the enhancements made to the prototype before deployment to the CART site and the development of the automated analysis software for the AERI prototype at CART available for use in the retrospective analysis of AERI data from SPECTRE. The net result is that the SPECTRE data is being processed in a manner consistent with the CART data and is thus directly comparable. The only major difference is that the new observations collected by the AERI prototype at CART contain a sky variance product not available earlier.

The four special case days you requested (911118, 911121, 911126, and 911204) have been reprocessed using the new AERI system analysis software (Release No. 1.0). To distinguish between the earlier calibrated results and the recalibrated data I will refer to the earlier results as the "Preliminary" calibration while the current results are the "final" calibration. The word "final" should be understood in the context of the SPECTRE project grant as representing our best effort at calibration given the knowledge of the instrument characteristics at the time end of the three year grant period. Additional refinements from those already included would be expected to be at the sub one-percent level. All other SPECTRE days are currently undergoing the same recalibration so that a complete AERI data set for SPECTRE should be available within a week or so.

You may well ask what is the difference between the preliminary and the final calibration. Four major differences should be pointed out; (1) use of the Hot-Ambient blackbody cavities in calibration rather than the Ambient-Liquid Nitrogen cavities, (2) a correction for the nonlinearity of the longwave channel detector, (3) a correction for the interferometer finite field of view effect and (4) a "resampling" to place the data on a standard wavenumber scale to facilitate comparison to calculations and other FTIR instruments. The effect on the spectra is summarized in the enclosed plots of differences between preliminary and final calibration. In words, the use of Hot-Ambient calibration removes a calibration uncertainty associated with the cloud that forms over the liquid nitrogen blackbody cavity. The size of this effect ( $750\text{-}950\text{ cm}^{-1}$ ) varies greatly depending on the local wind conditions since a strong breeze causes the LN2 cavity to "steam" much more than when conditions are calm. One disadvantage of the use of the Hot-Ambient calibration is that the noise level of the data will appear somewhat larger than the previous Ambient-LN2 calibration, though still entirely adequate for spectroscopic study when the average of a time sequence of sky views is used. New calibration software is being written under the ARM program for future AERI measurements which will make use of time averaging of the calibration reference sources and thereby reduce the noise to a level comparable to the earlier results. The nonlinearity correction is unique and is an outgrowth of the ARM IDP program work of Hank Revercomb. The MCT longwave detector has an inherent nonlinear dependence on incident radiation, unlike the InSb shortwave detector which is highly linear. The effect of the nonlinearity correction is largest in the atmospheric longwave window and is typically of the order of  $1\text{ mW}/(\text{m}^2\text{ cm}^{-1}\text{ sr})$ . The correction for the finite field of view is straightforward once the effective instrument field of view (which depends on the instrument field stop size and optical alignment) is known. The effect of this correction is to remove the inherent "self-apodization" and thus restore the lines to their natural amplitude. Since the FFOV effect is wavenumber dependent, the largest changes occur in the shortwave band in regions containing line structure (i.e.  $2000\text{-}2200\text{ cm}^{-1}$ ). The resampling of the data to a standard wavenumber scale is performed using a "zero fill" technique in the Fourier domain and interpolation. This can be performed very accurately and has the considerable advantage of placing the data on a common scale for intercomparisons.

A word about data format. The data which I am making available to you immediately is in a data format very similar to the one in which the preliminary data was provided, i.e. scaled integer values in a binary FORTRAN direct access record format. We have facilitated access to the format by providing a C-language module (known as AERIFORM) which can be either linked into another program or compiled as a stand alone program. The AERIFORM module acts as a "metadata" interface to the scaled integer data and contains all the necessary descaling factors and parameter descriptors to describe the data. However, I know that you will be receiving data from the ARM program in netCDF format and that if you would like to focus your effort on data in that form. For this reason, in addition to the scaled integer data (AERI native format) we will be providing a netCDF version of the data which is as consistent as possible to that being provided by the Experiment Center through the ARM program. We need to develop and check out the software to do this at Wisconsin, but I think that in one or two weeks we can provide you with netCDF versions of all of the data.

I am in the process of putting together a final report for the three year SPECTRE project which I will send to you (after all the data has been successfully transferred) to complete our contractual obligations. I will be including in this report all the details of the instrument operations and calibration corrections as well as examples of how the data has been used for remote sensing of atmospheric temperature, water vapor, and clouds.

This has been an extremely valuable project, both in its own right but also in support of the general development of the high resolution spectral instrumentation for the ARM program. I thank you for your support and look forward to continuing our work together.

Sincerely,

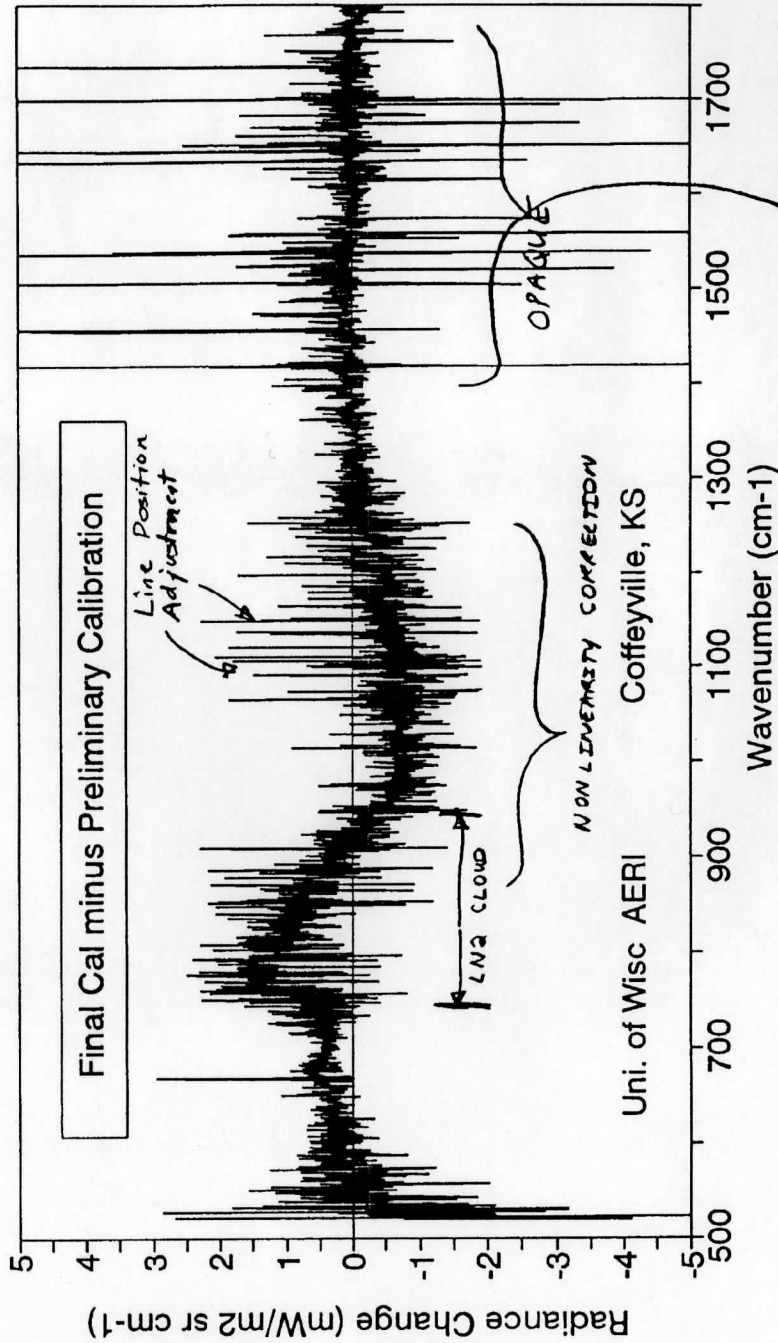
( signature)

Robert O. Knuteson

Enclosed Figures:

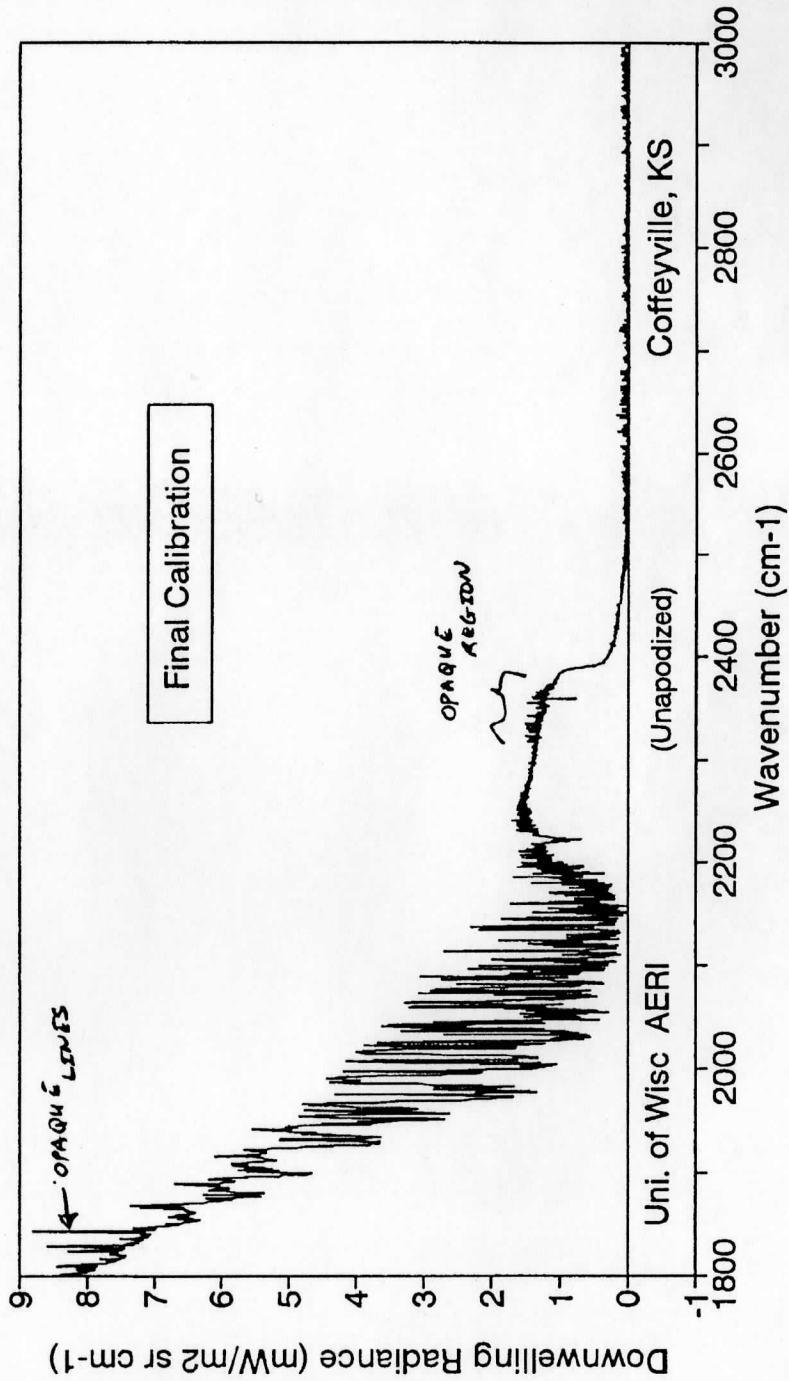
Final Calibrated Radiance for Four Case Days.  
Difference between Final and Preliminary Calibrations.  
Time sequence of Radiometric Data from "Summary" files.

AERI Data Correction (SPECTRE)  
18 NOV 1991 01:29:17 UTC

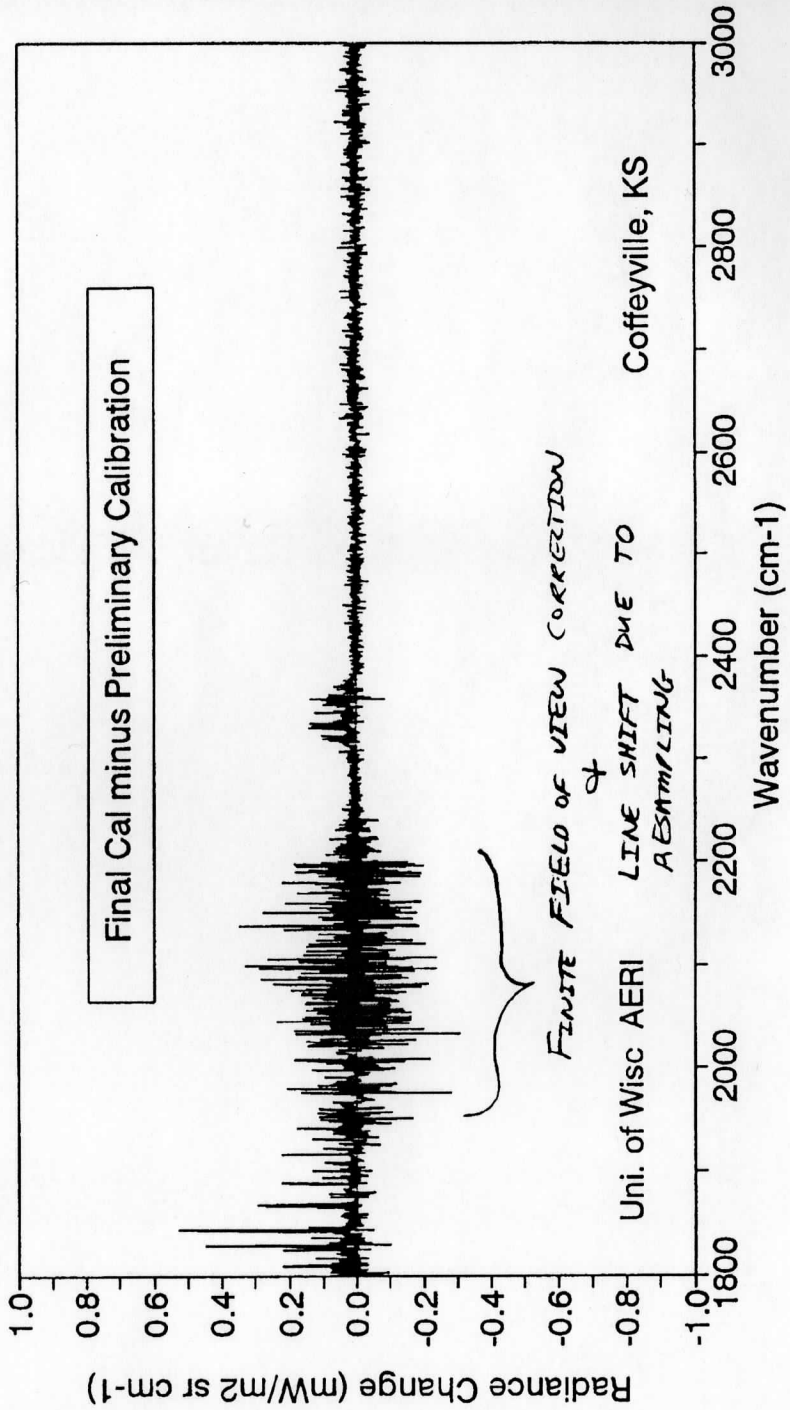


OPAQUE CHANNELS  
"BLIND" INSTRUMENT

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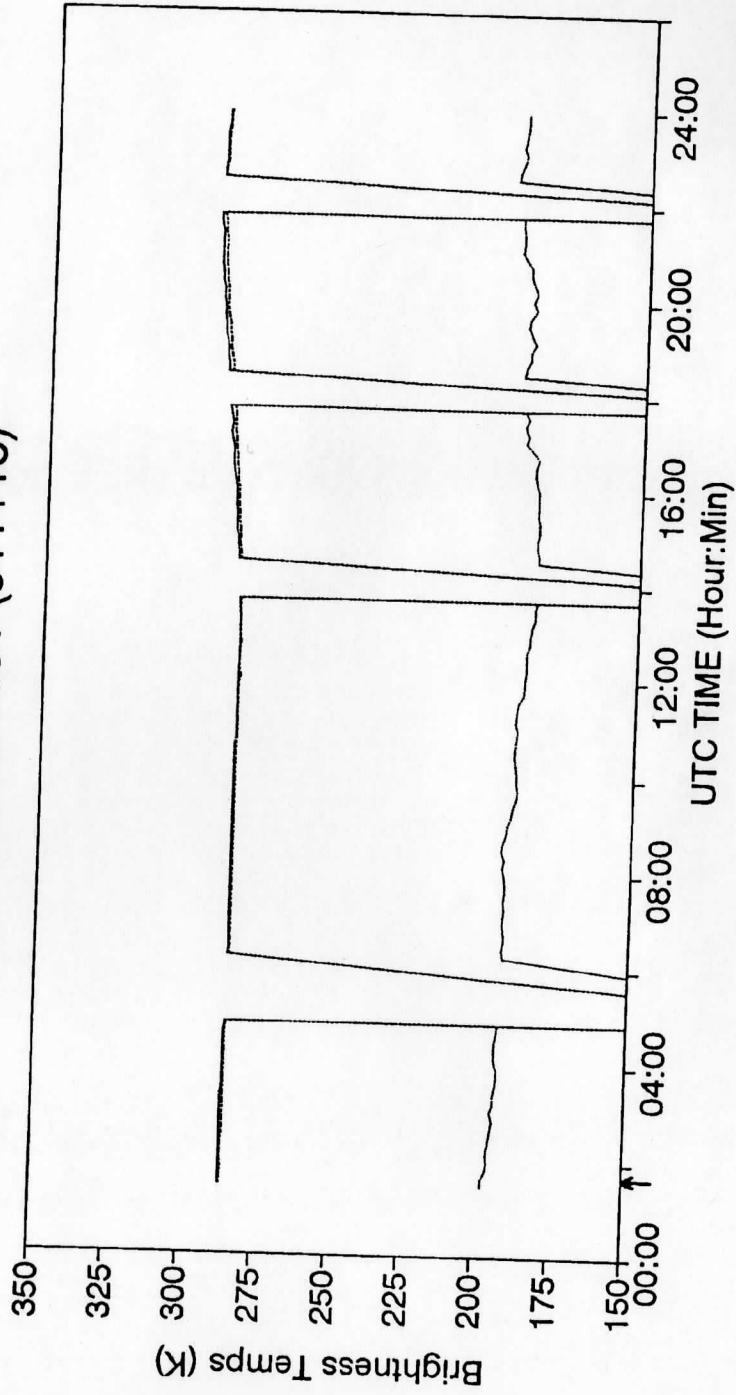


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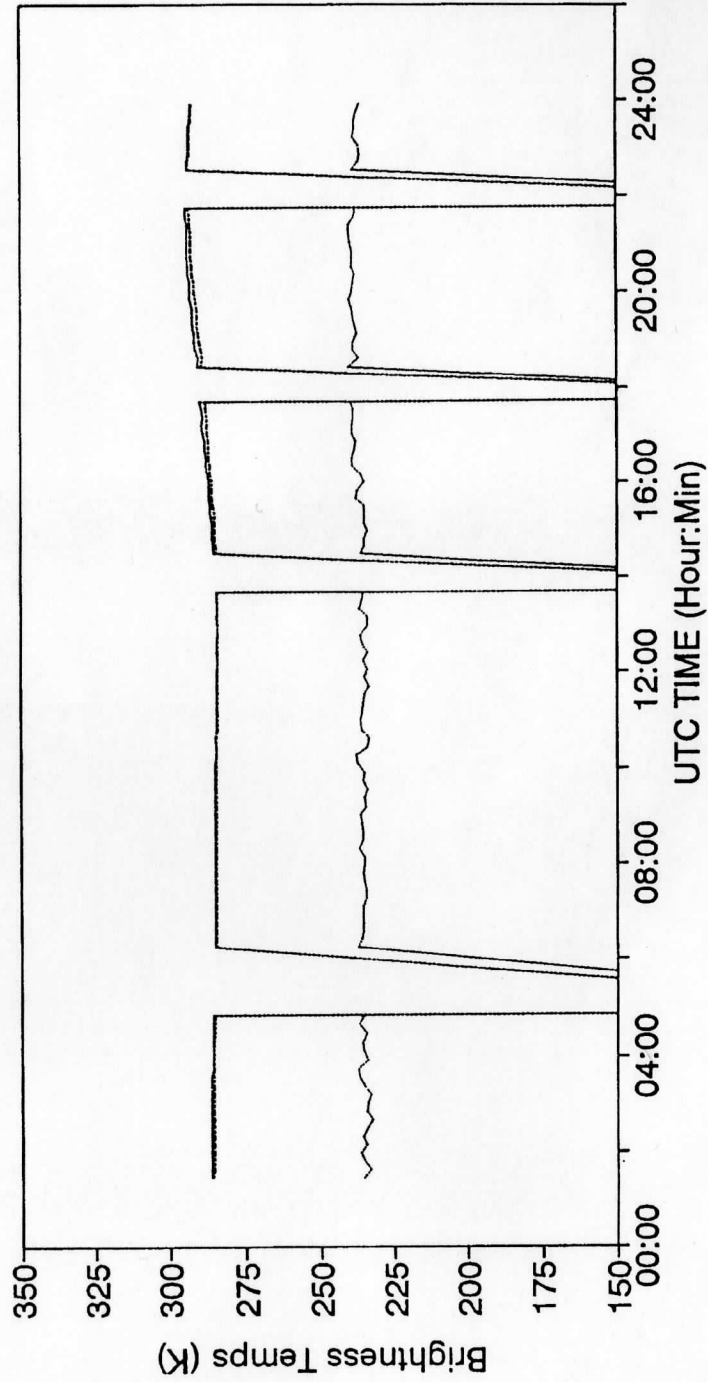


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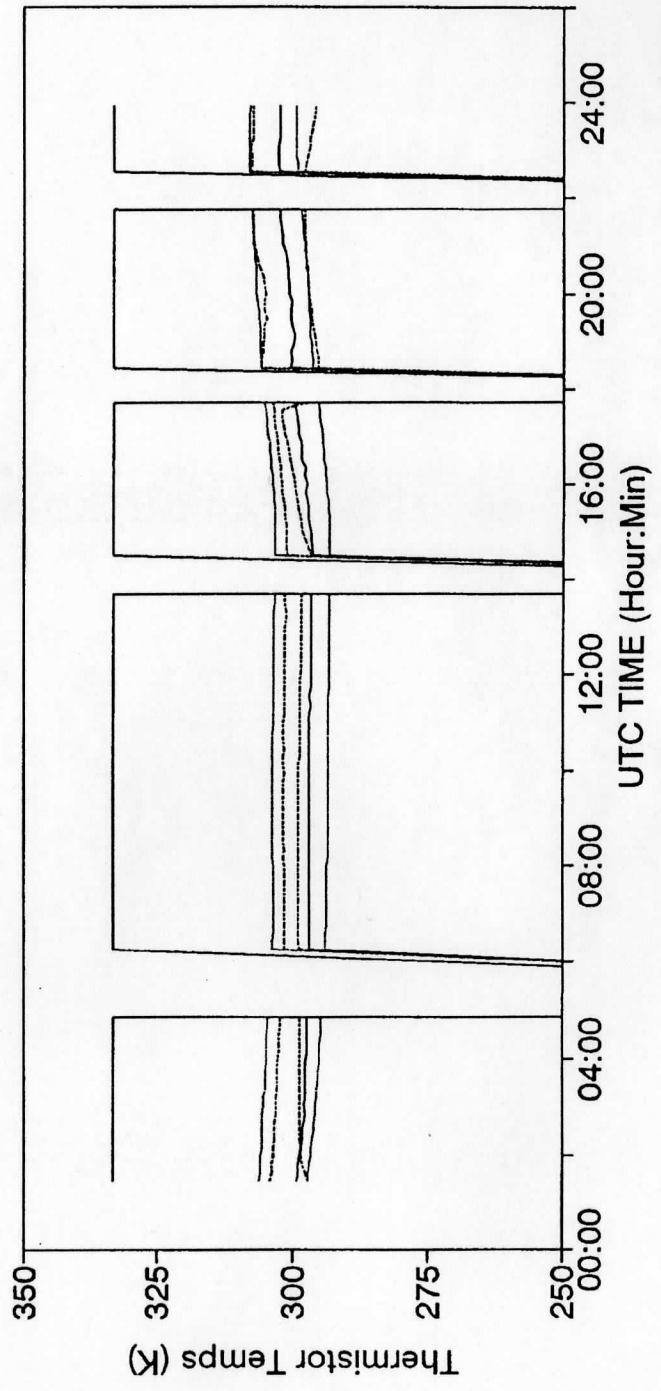
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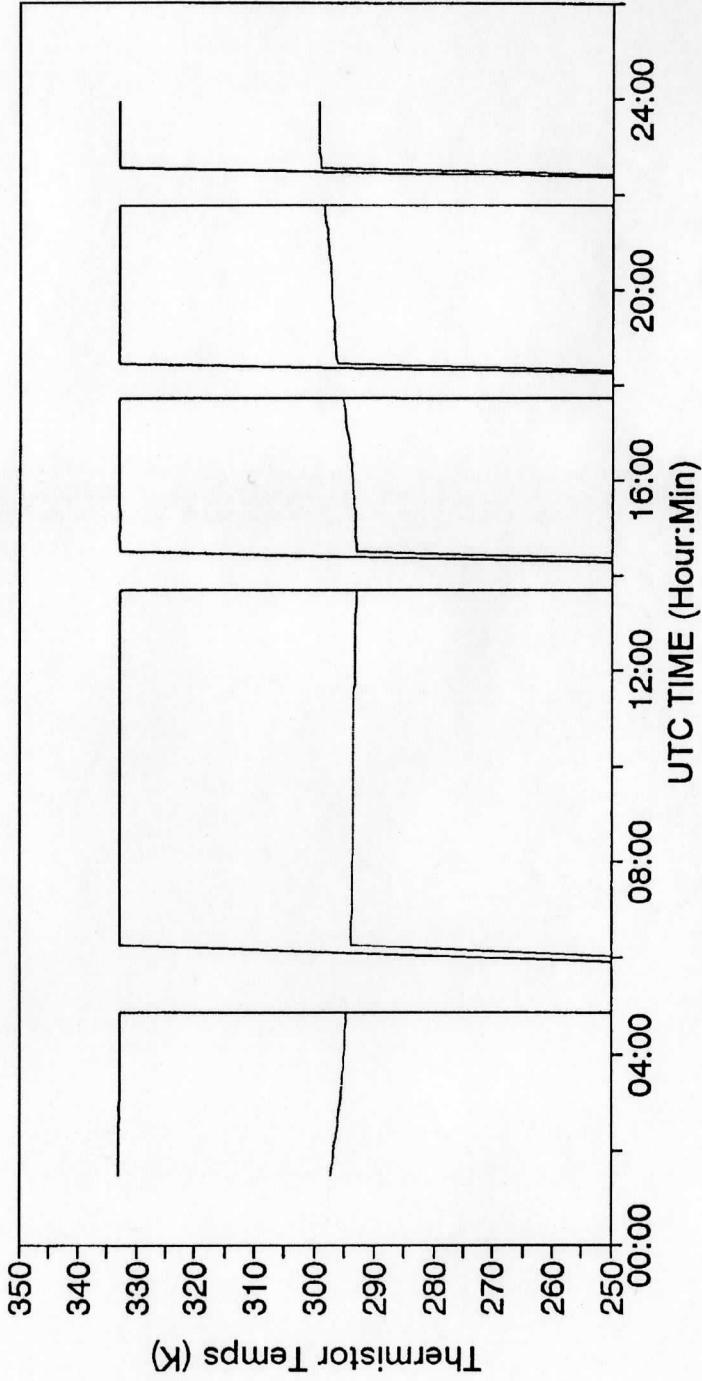
— AERI SP#4 2295 ..... AERI SP#5 2282 — AERI SP#6 2510



AERI Housekeeping Summary  
18 Nov 1991 (911118)

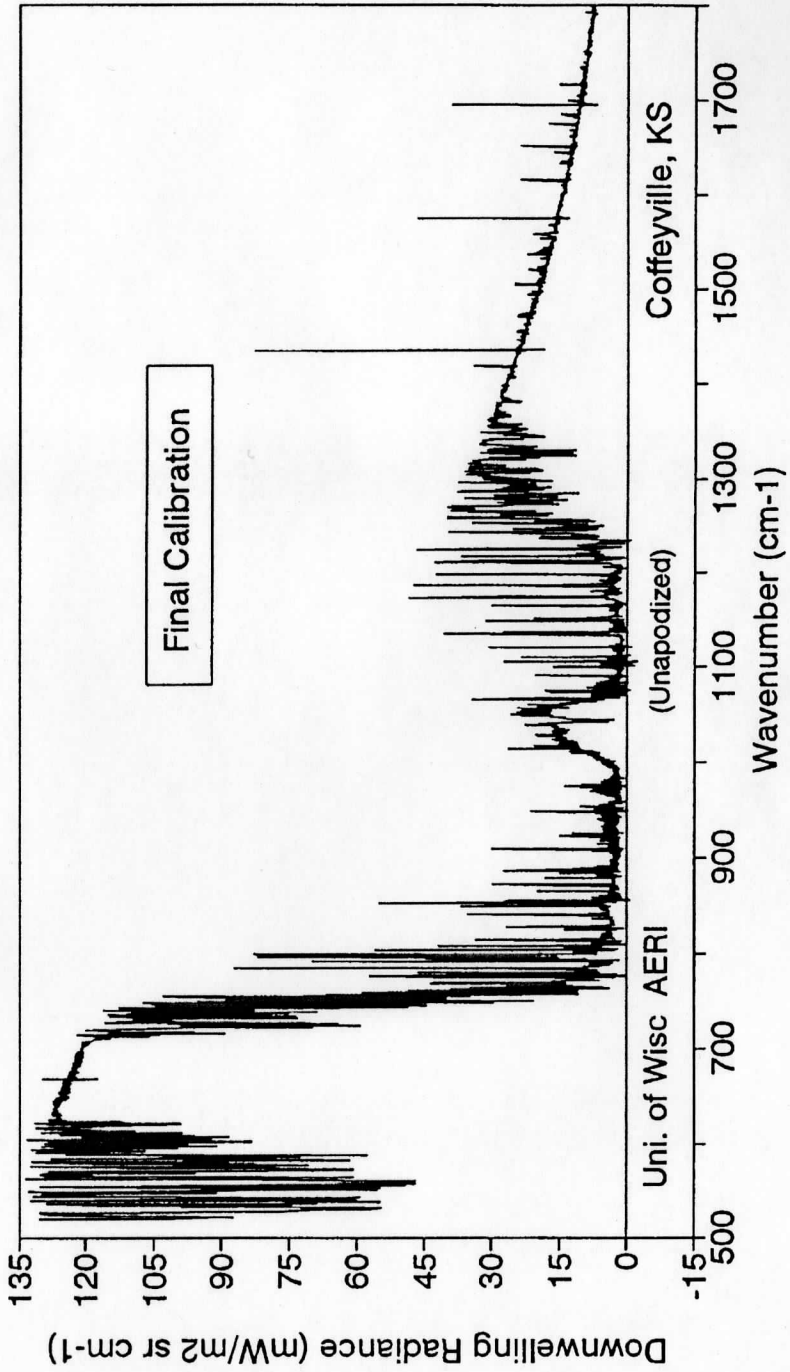


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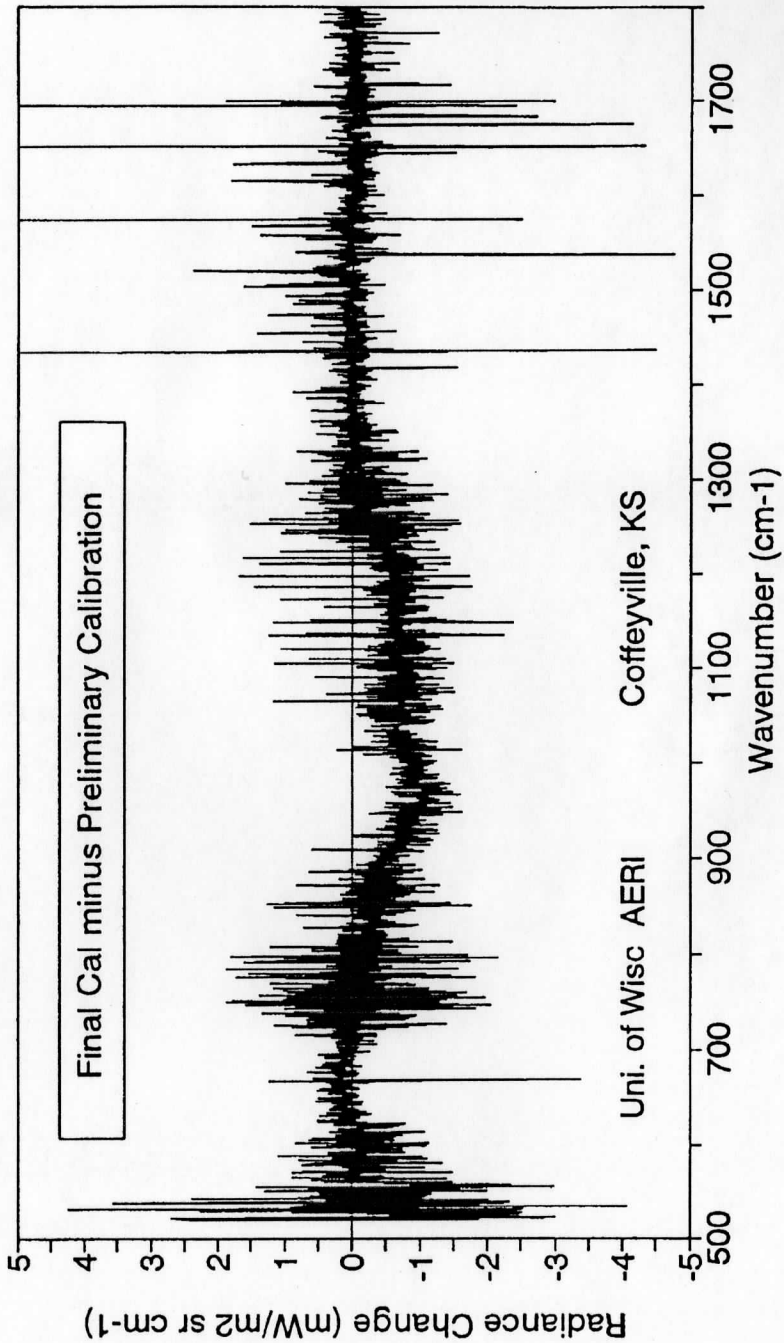


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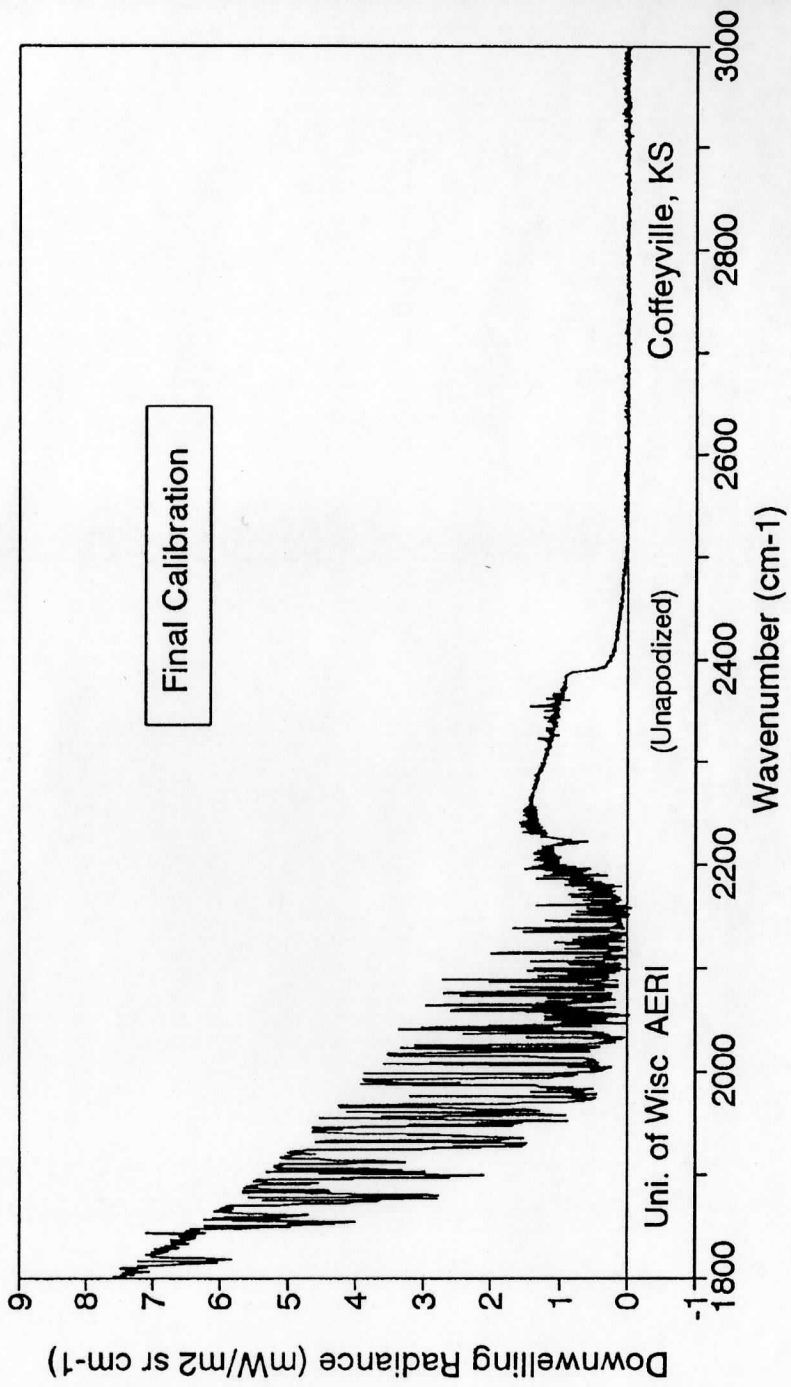
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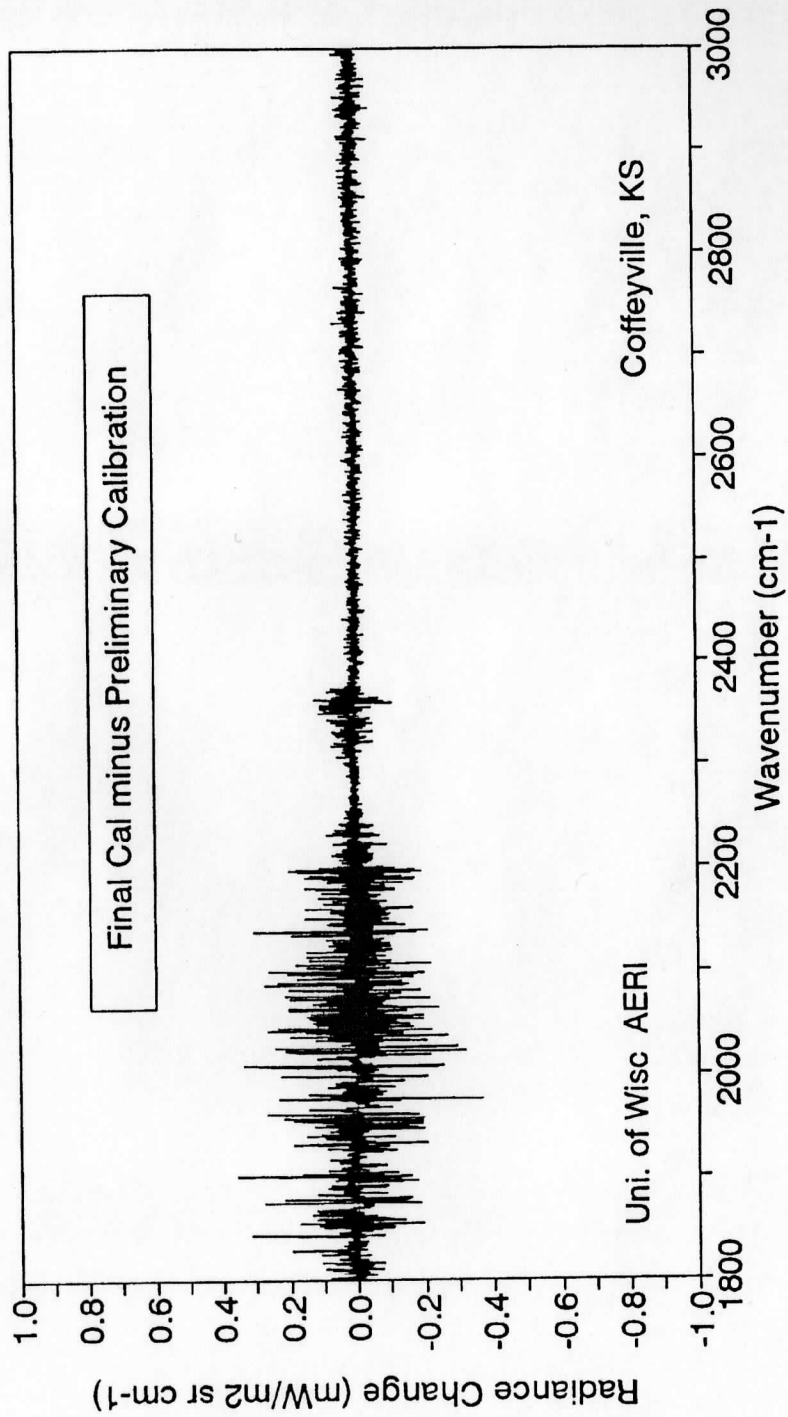
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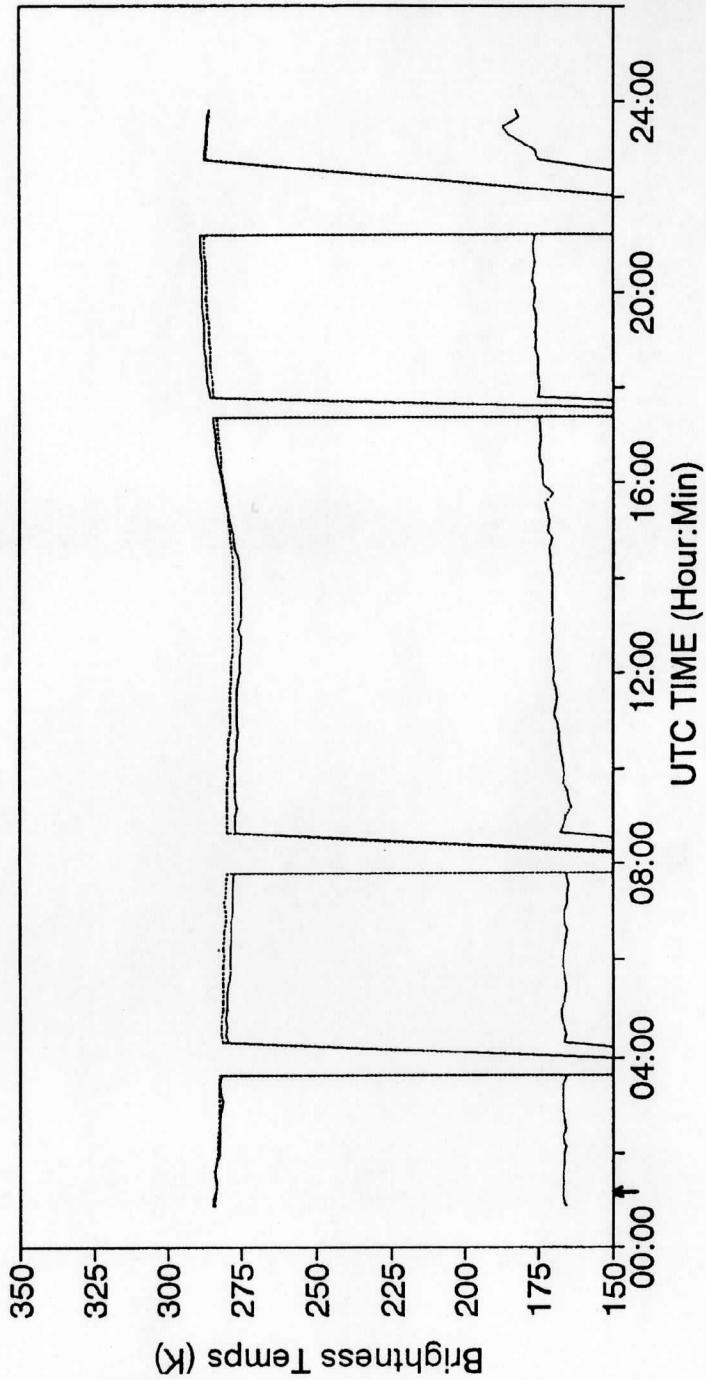


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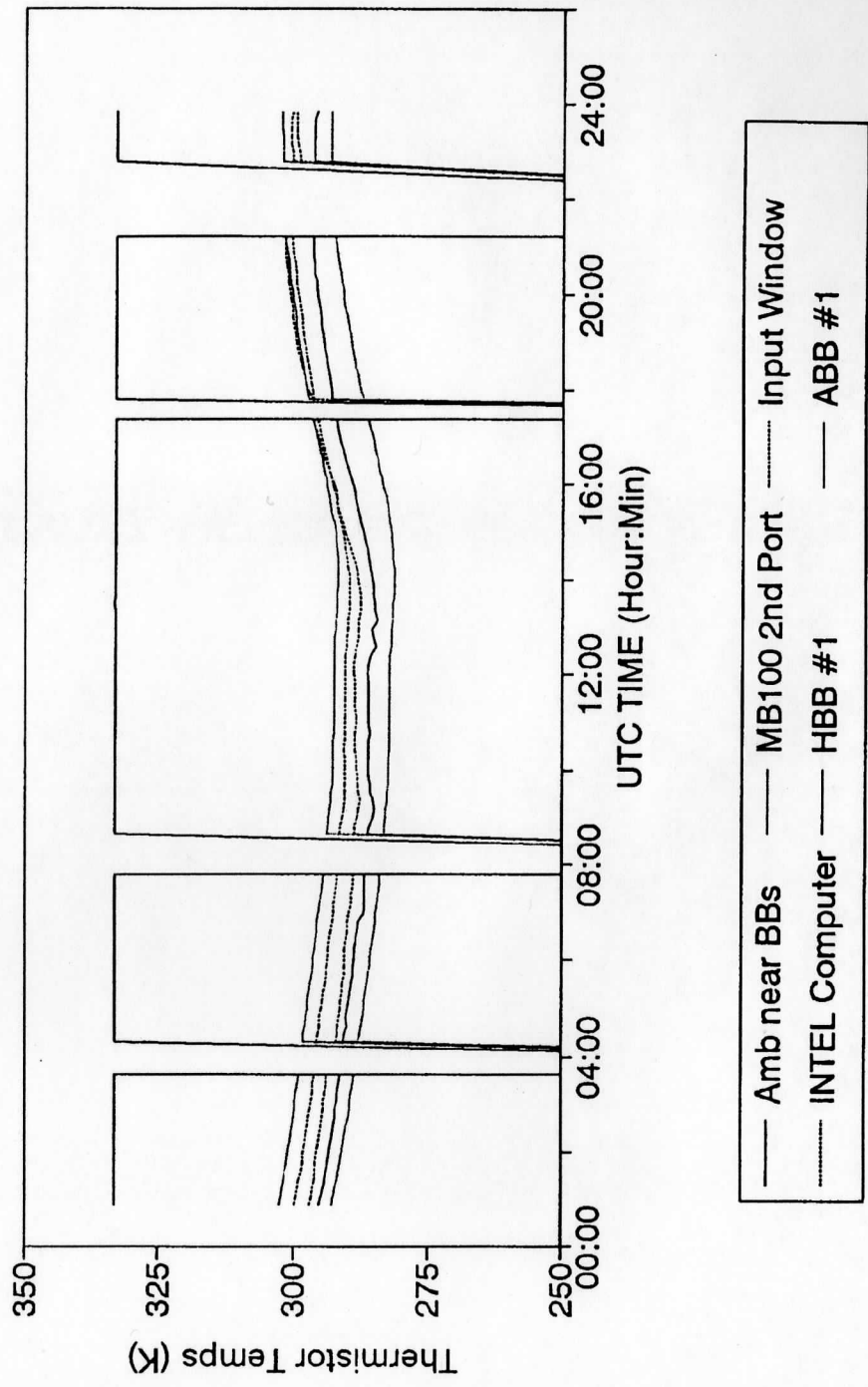


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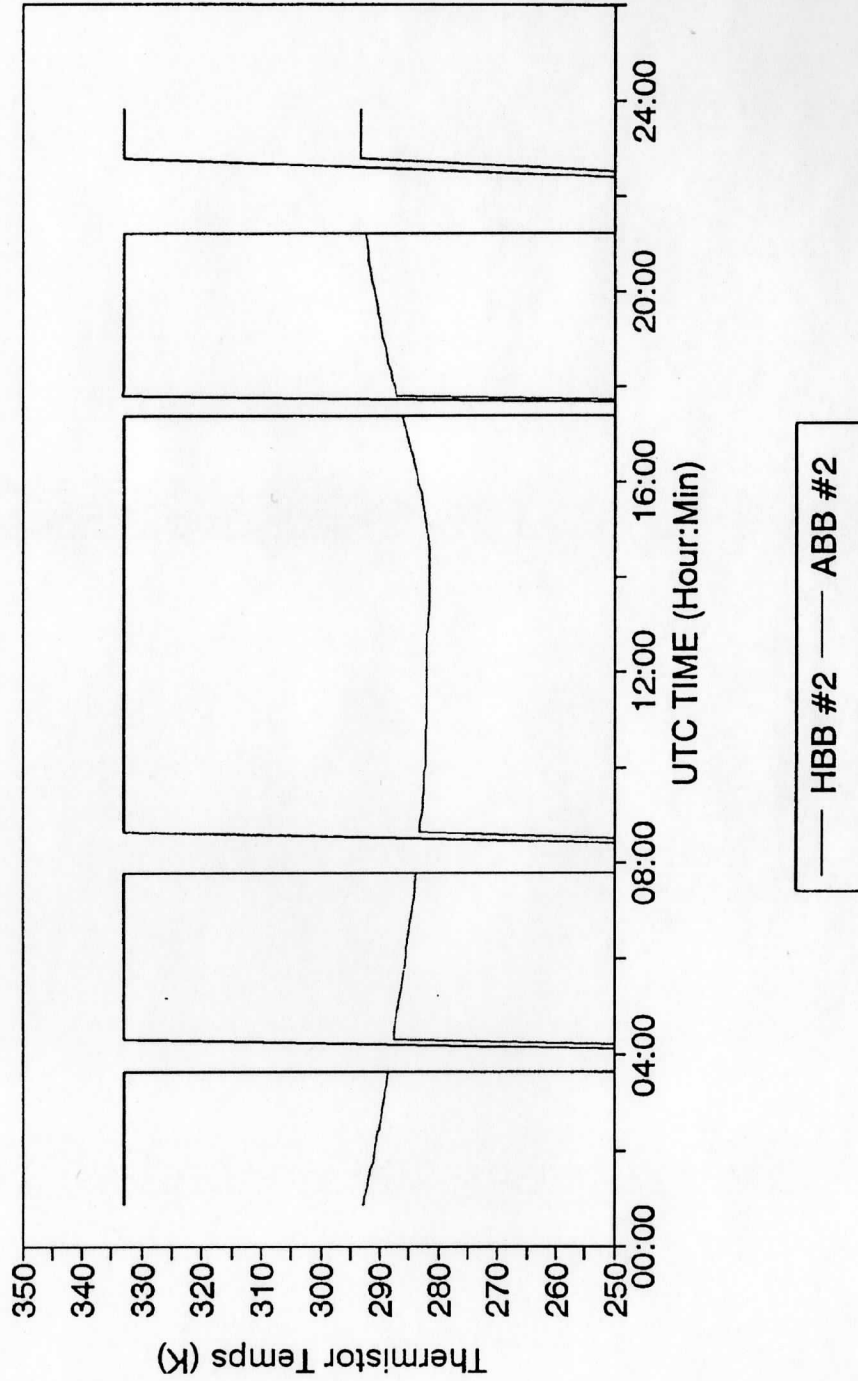


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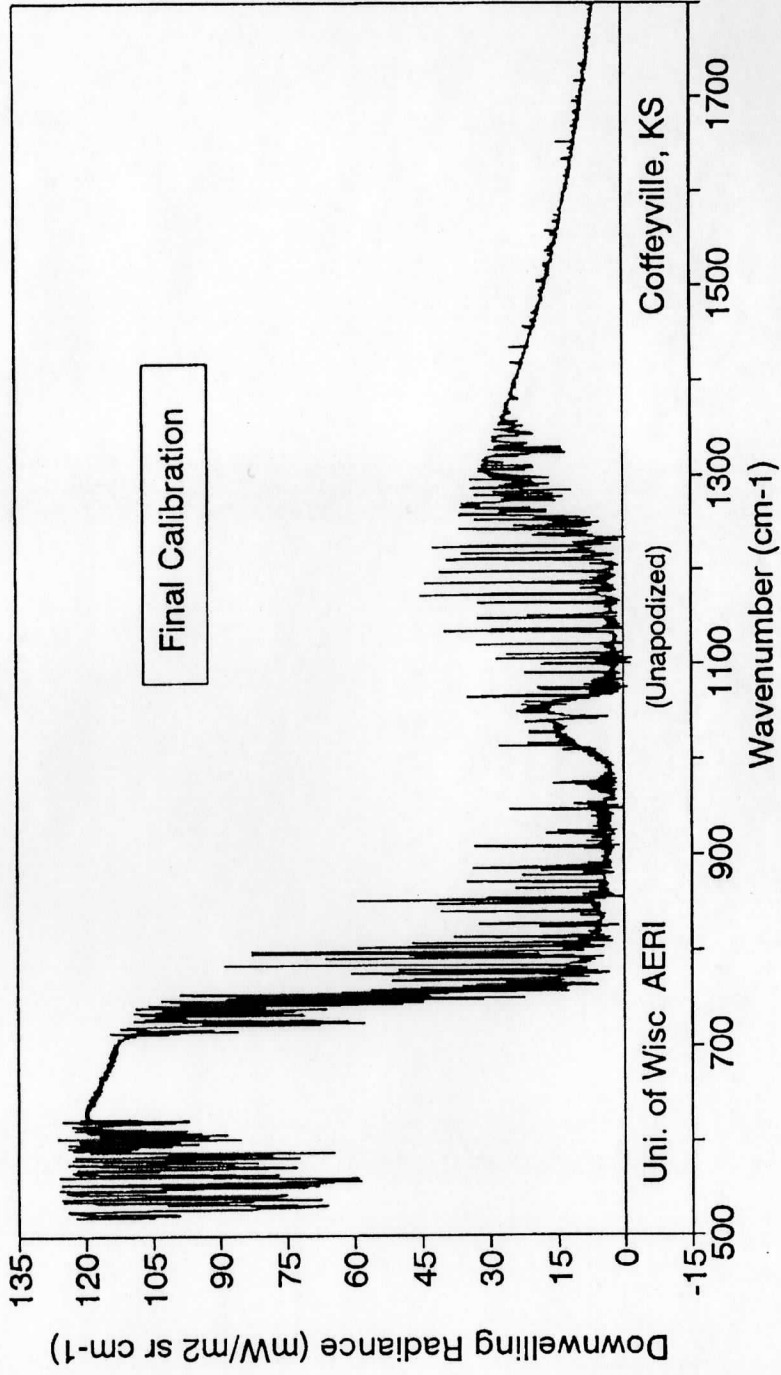
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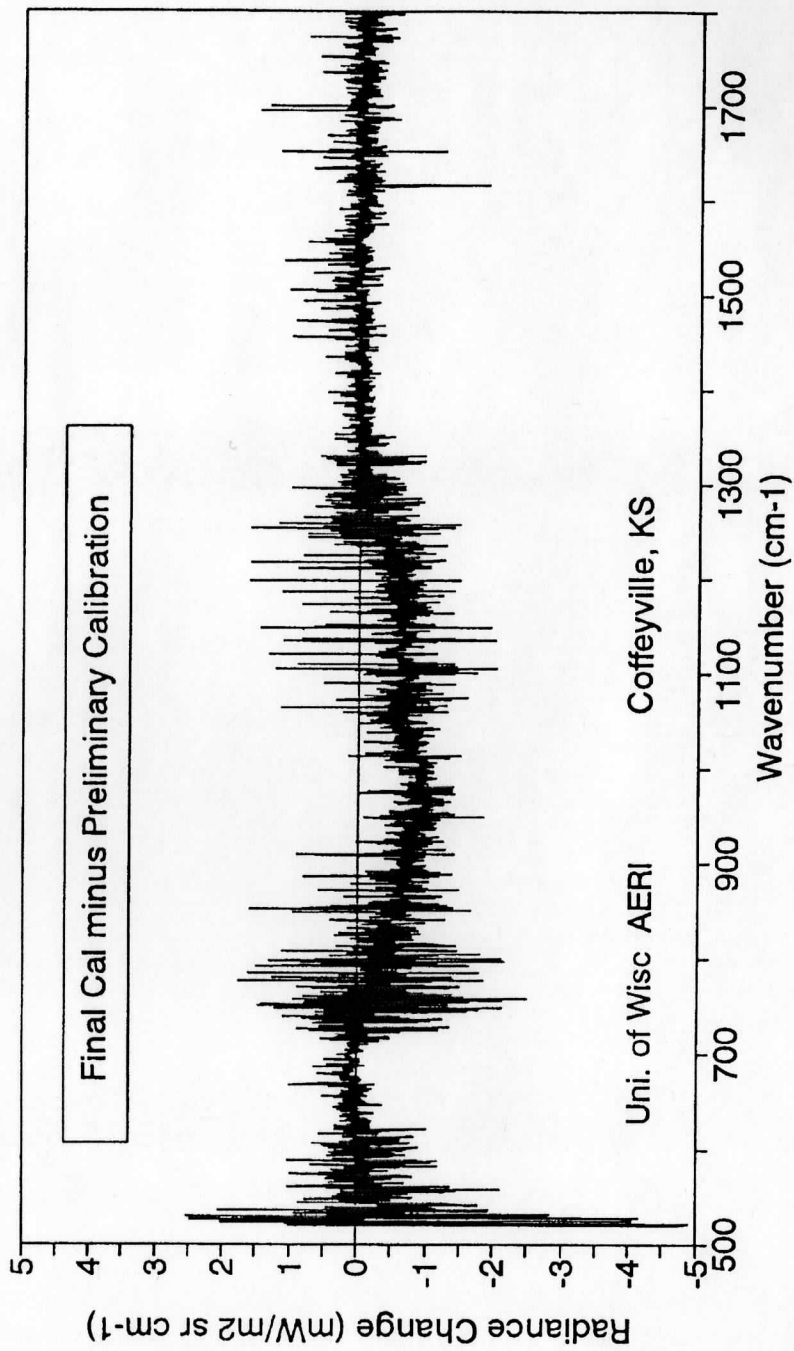
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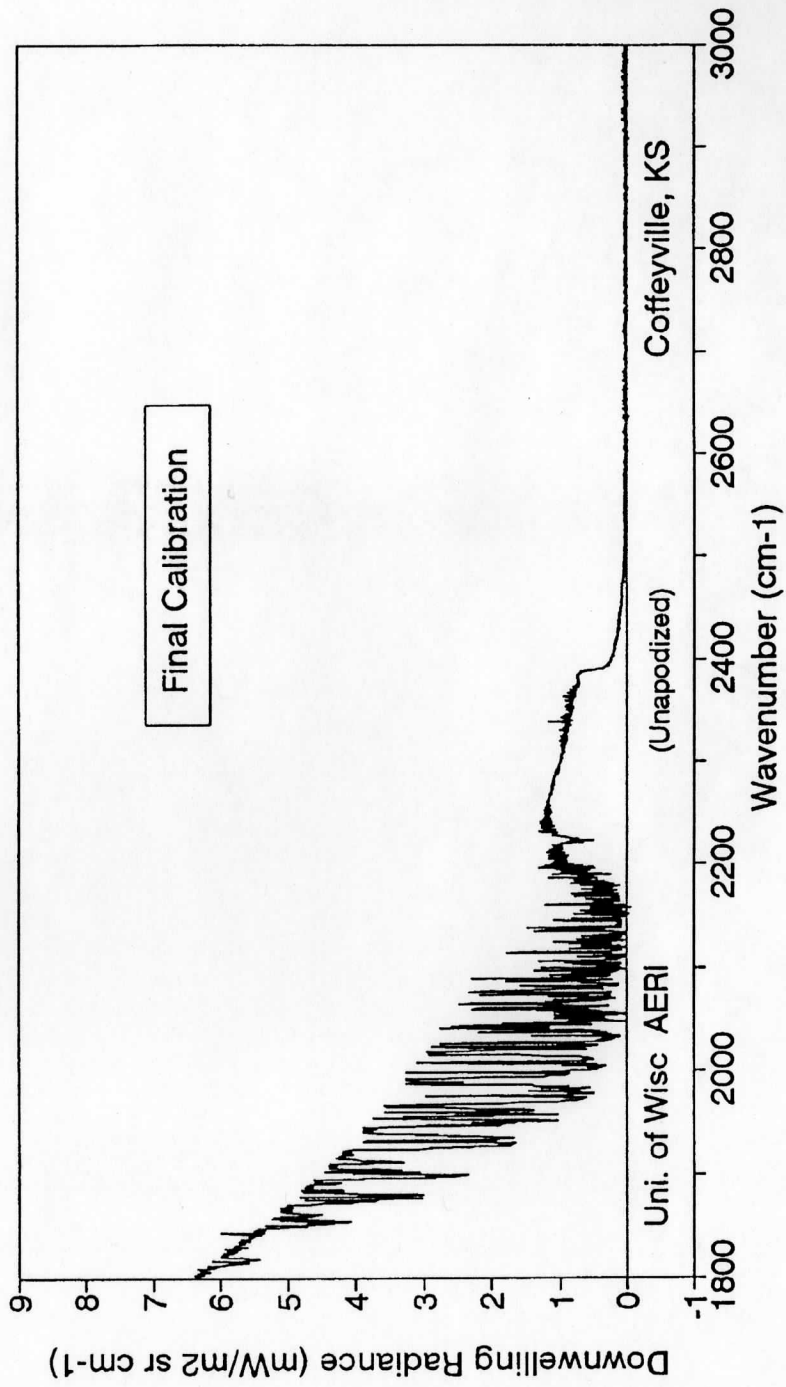
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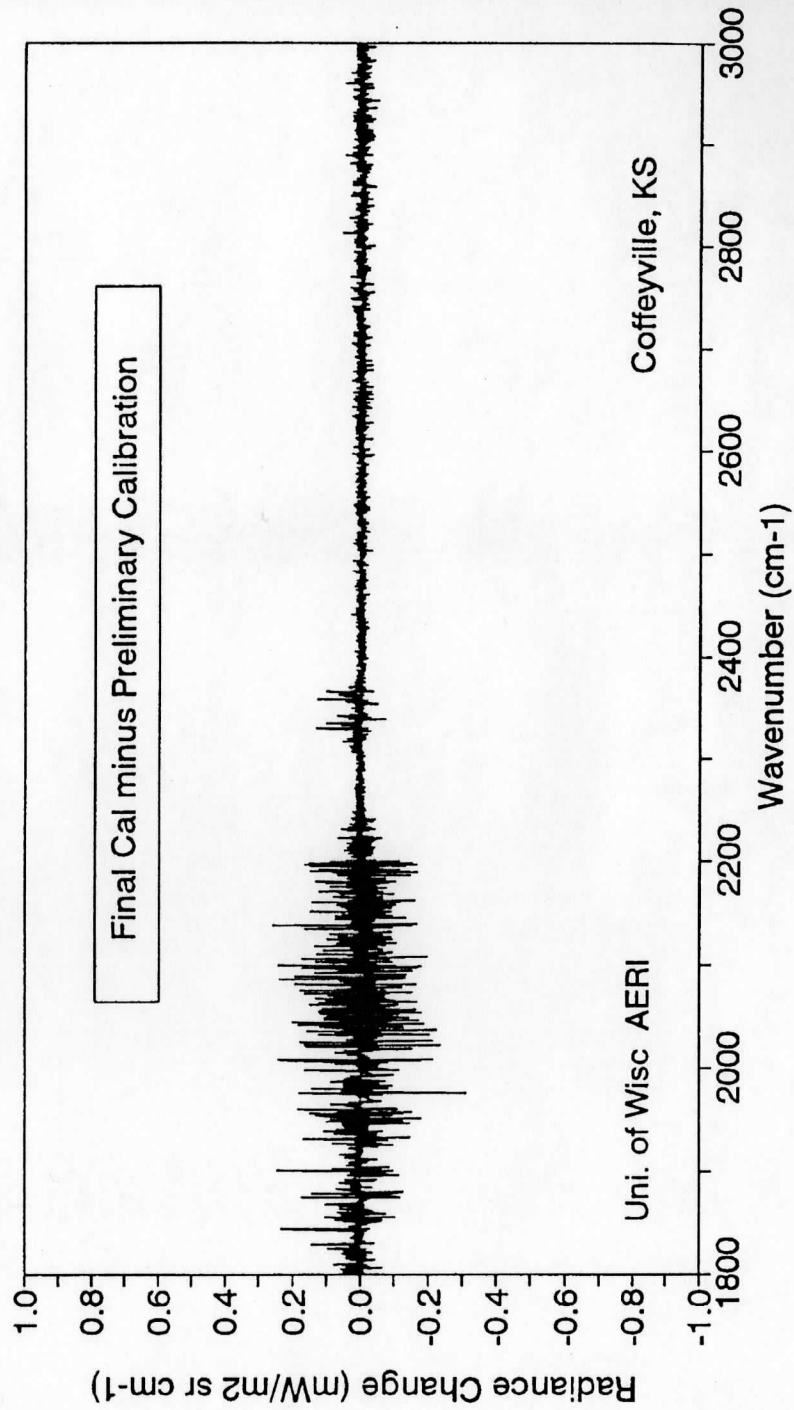


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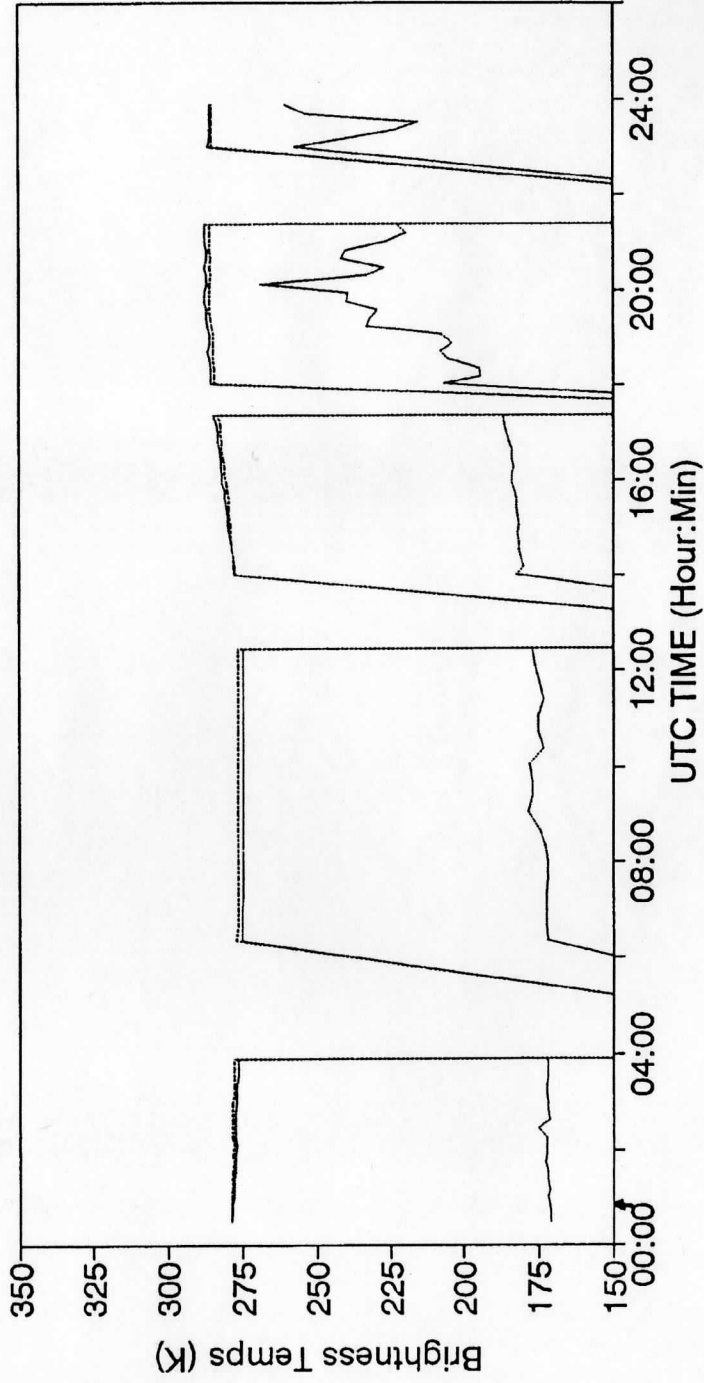




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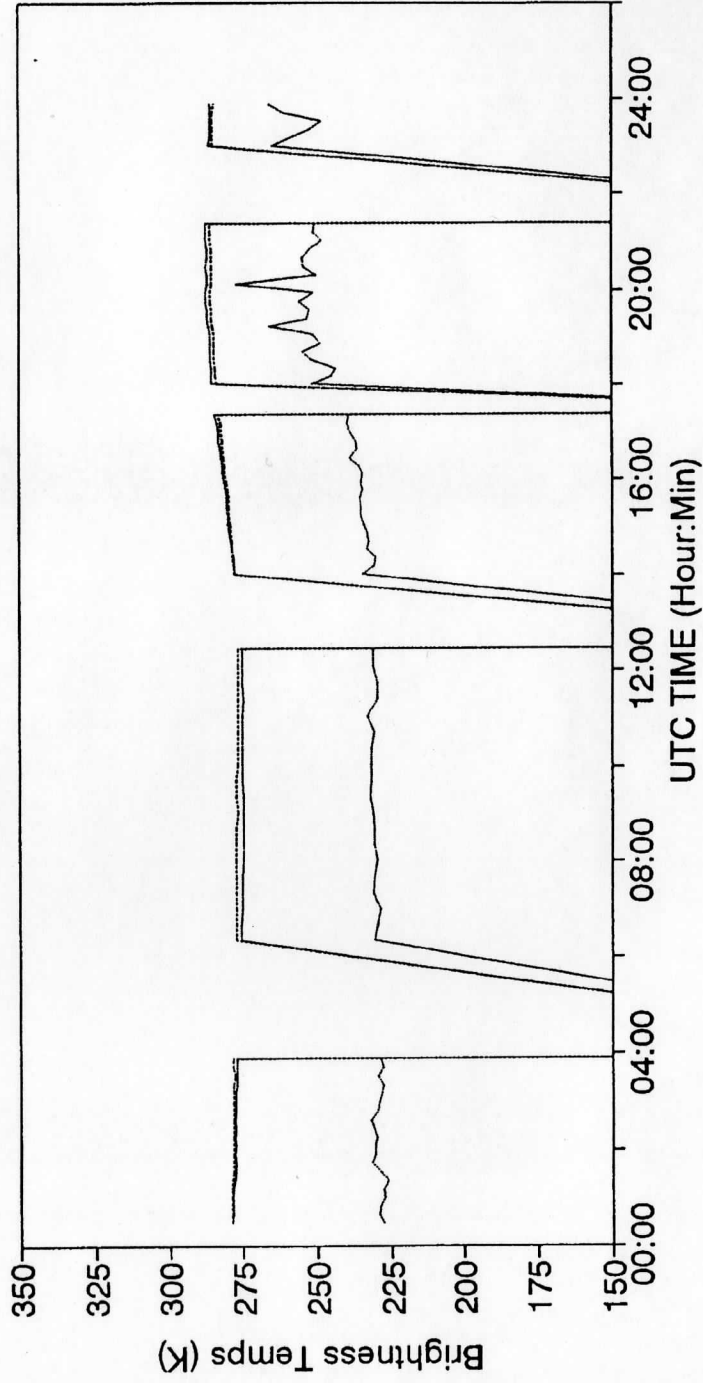


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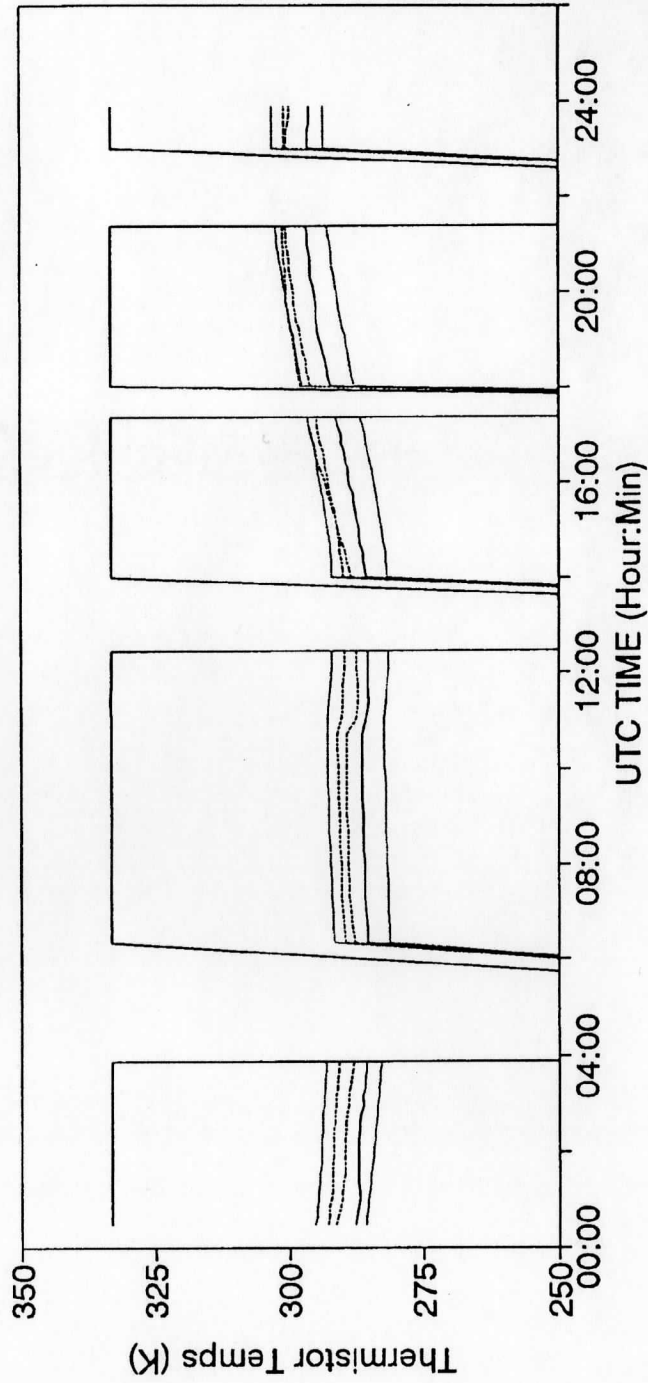
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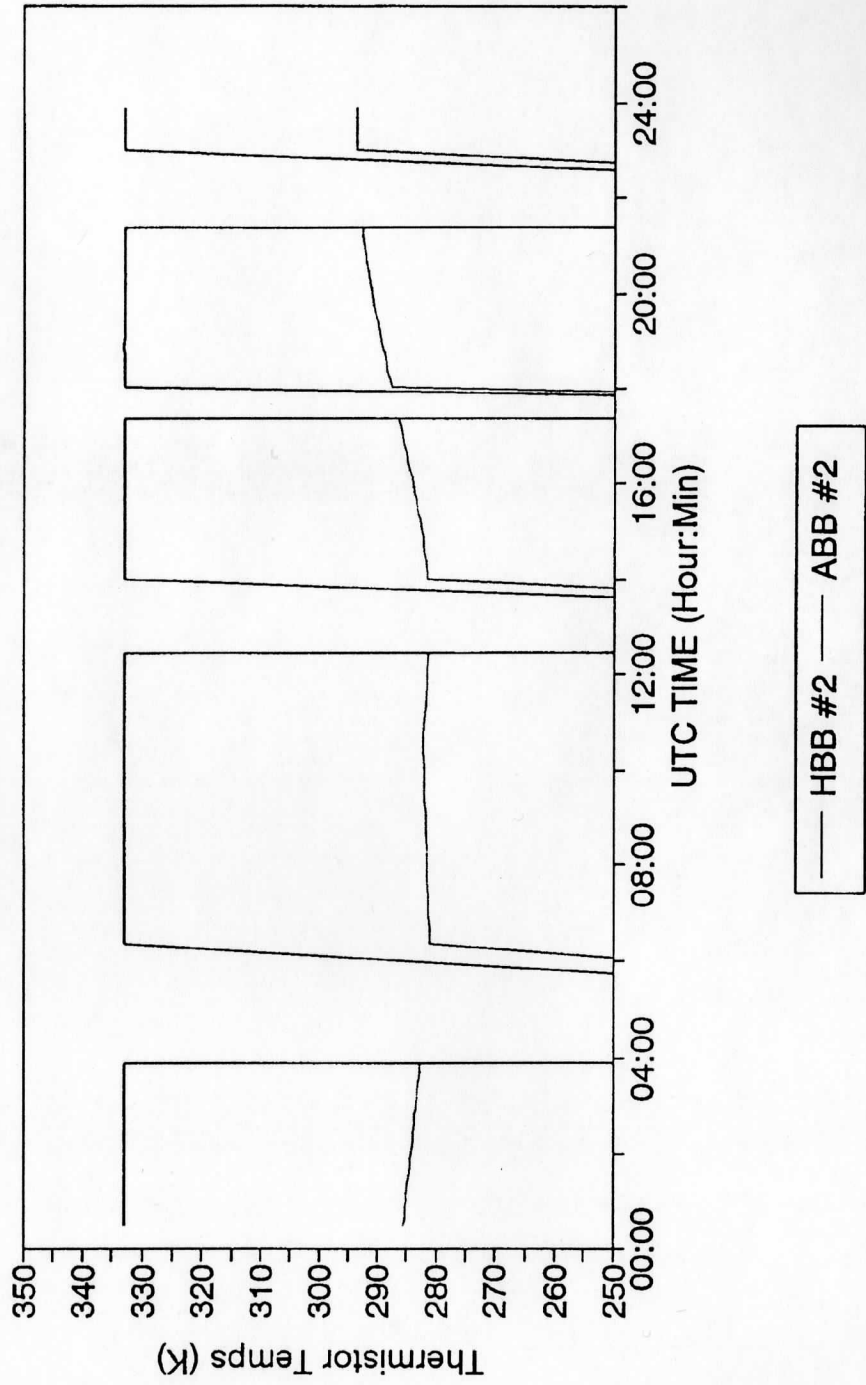


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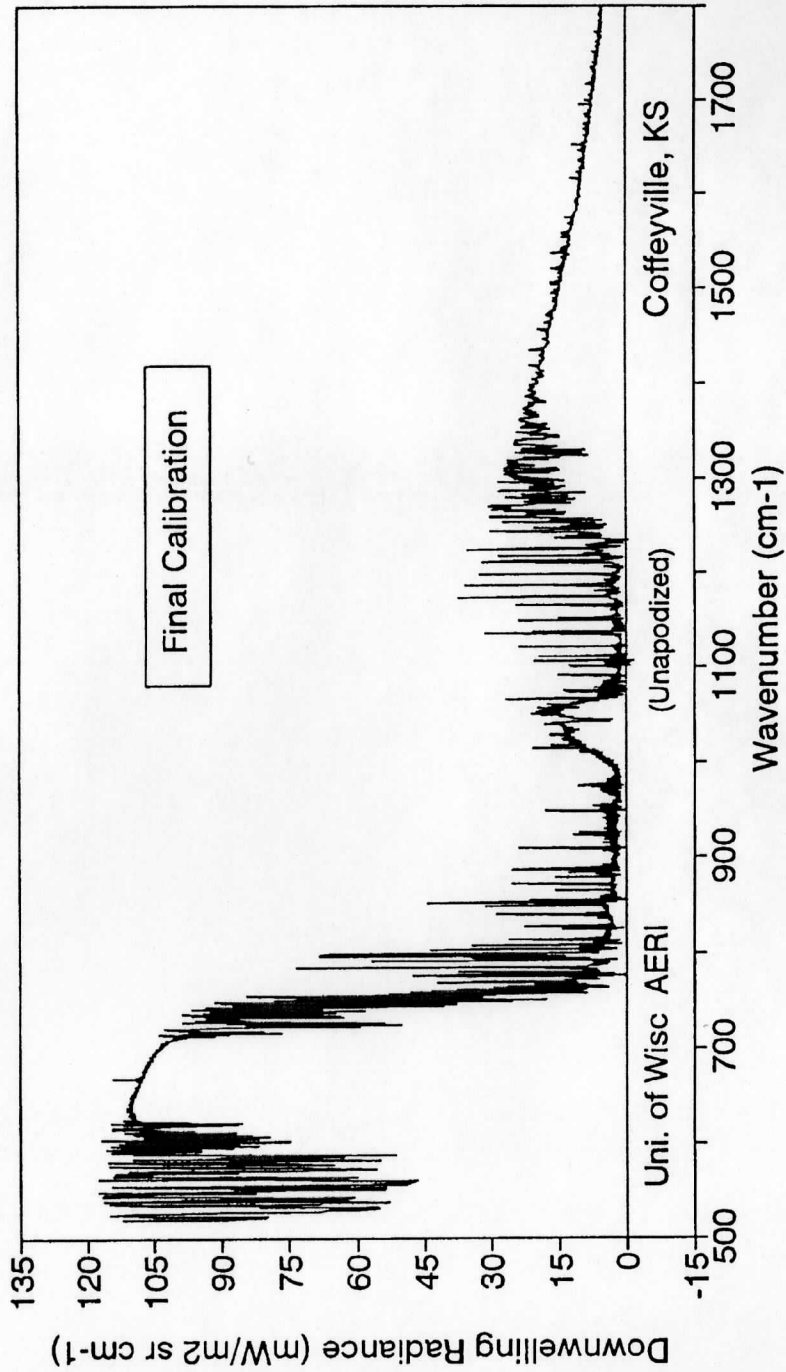
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AERI Housekeeping Summary  
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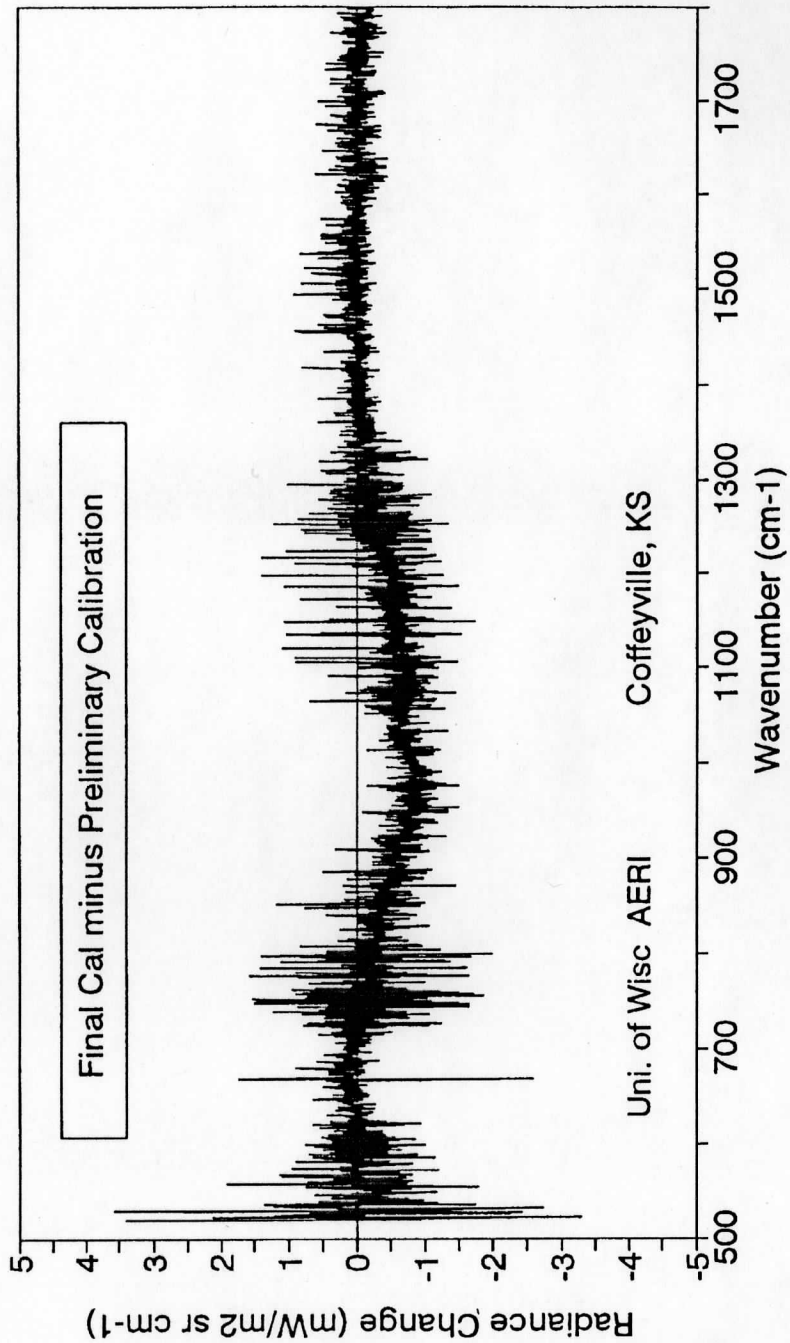


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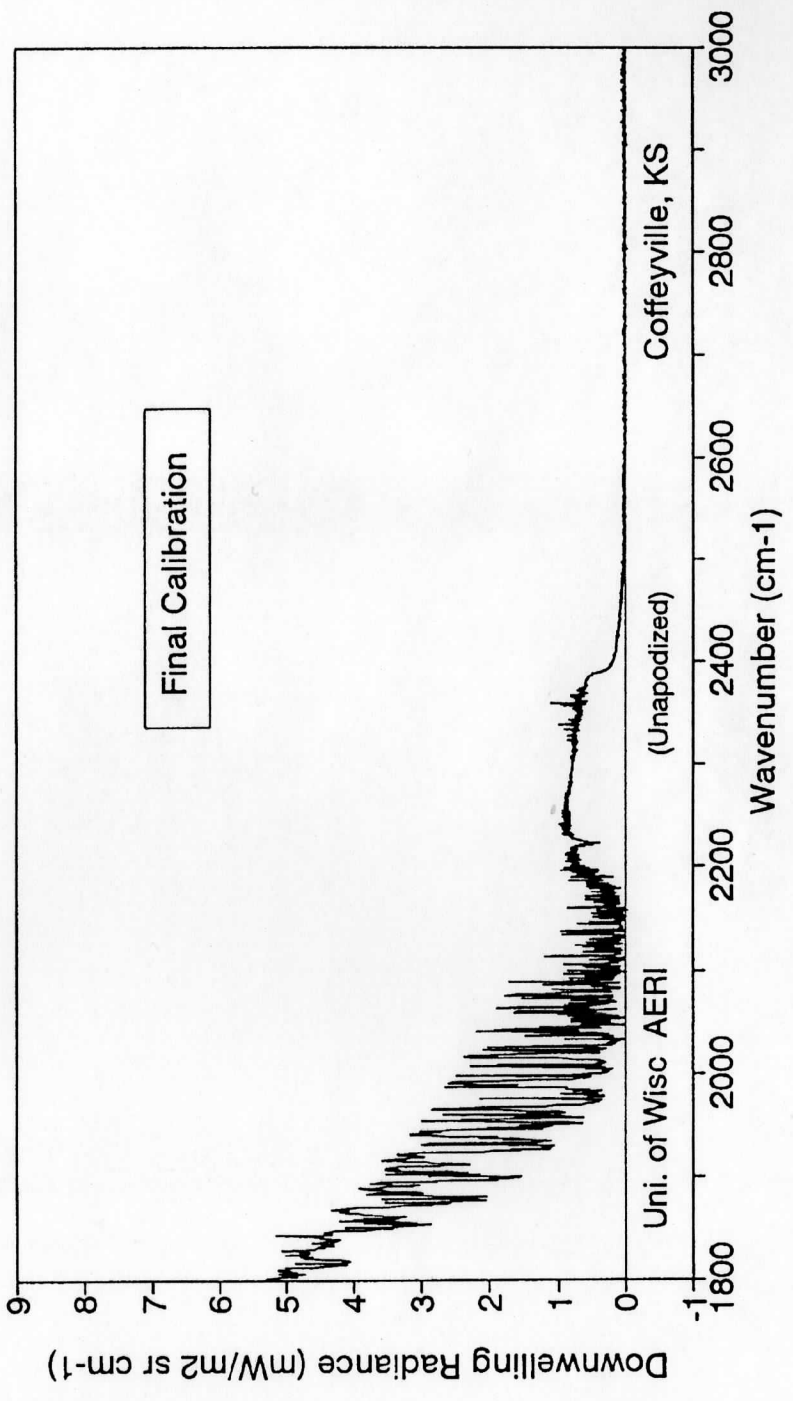




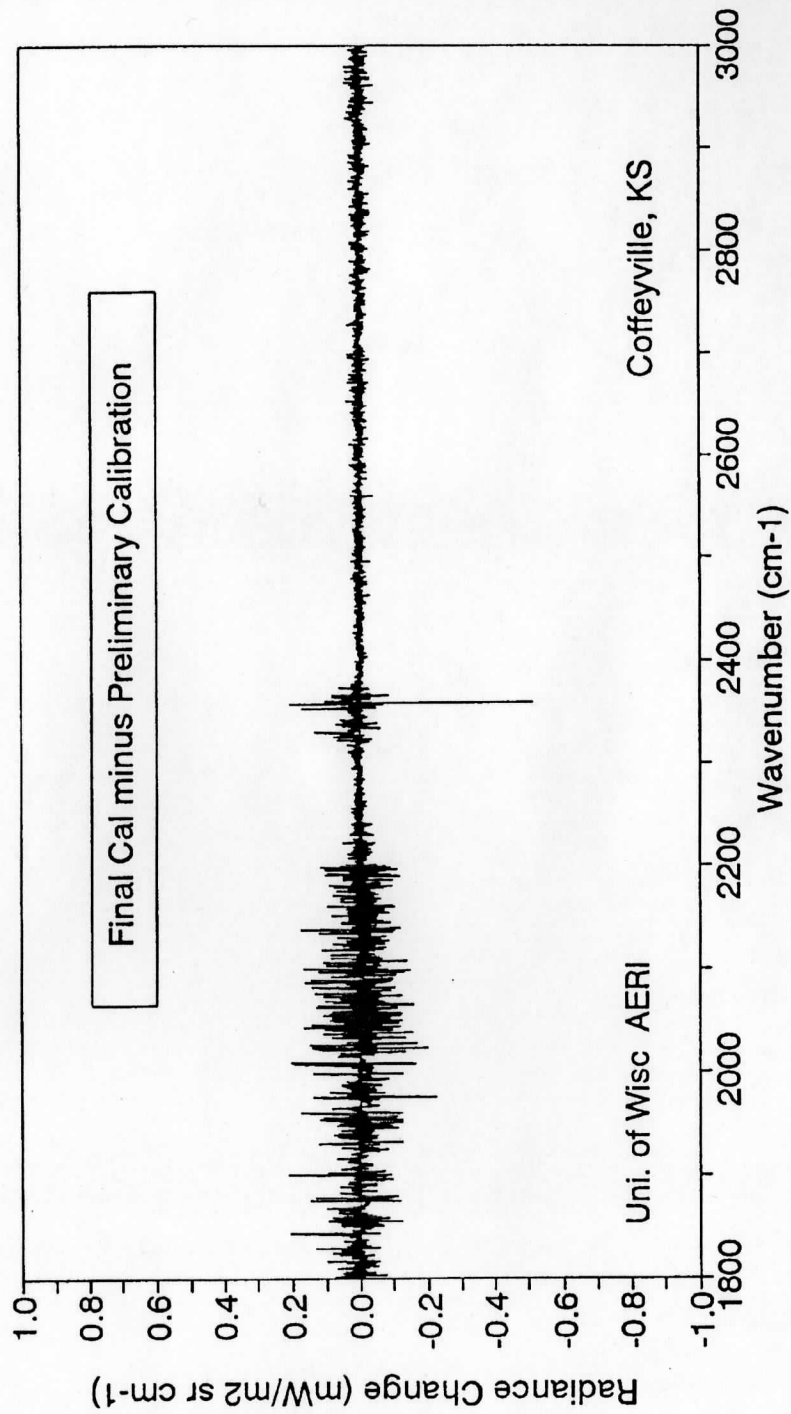
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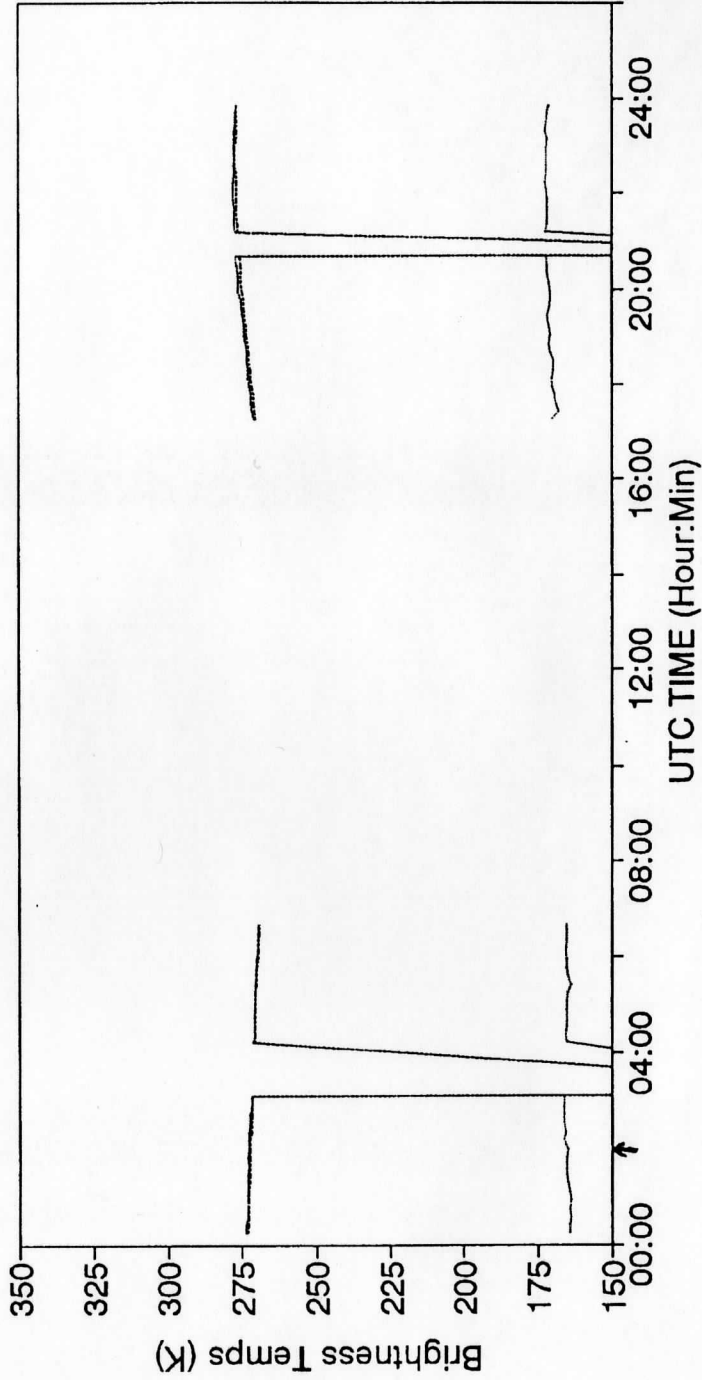
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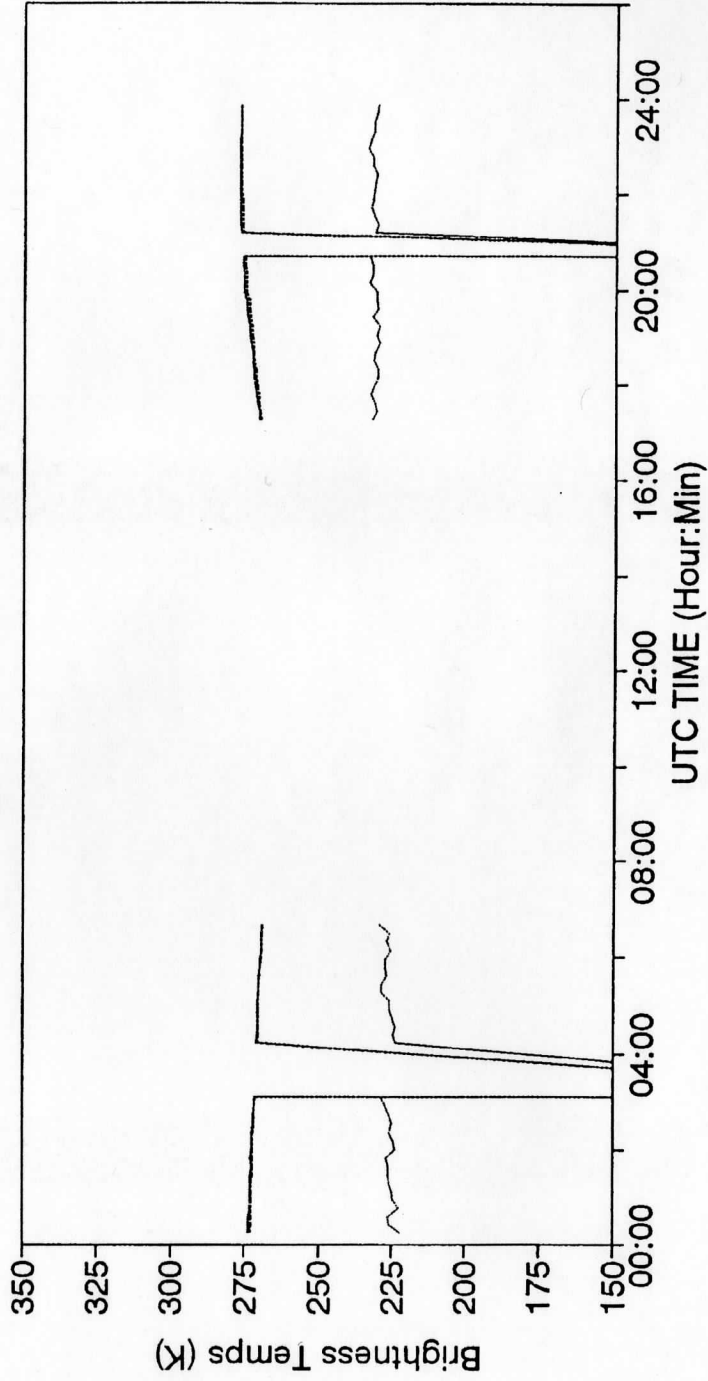


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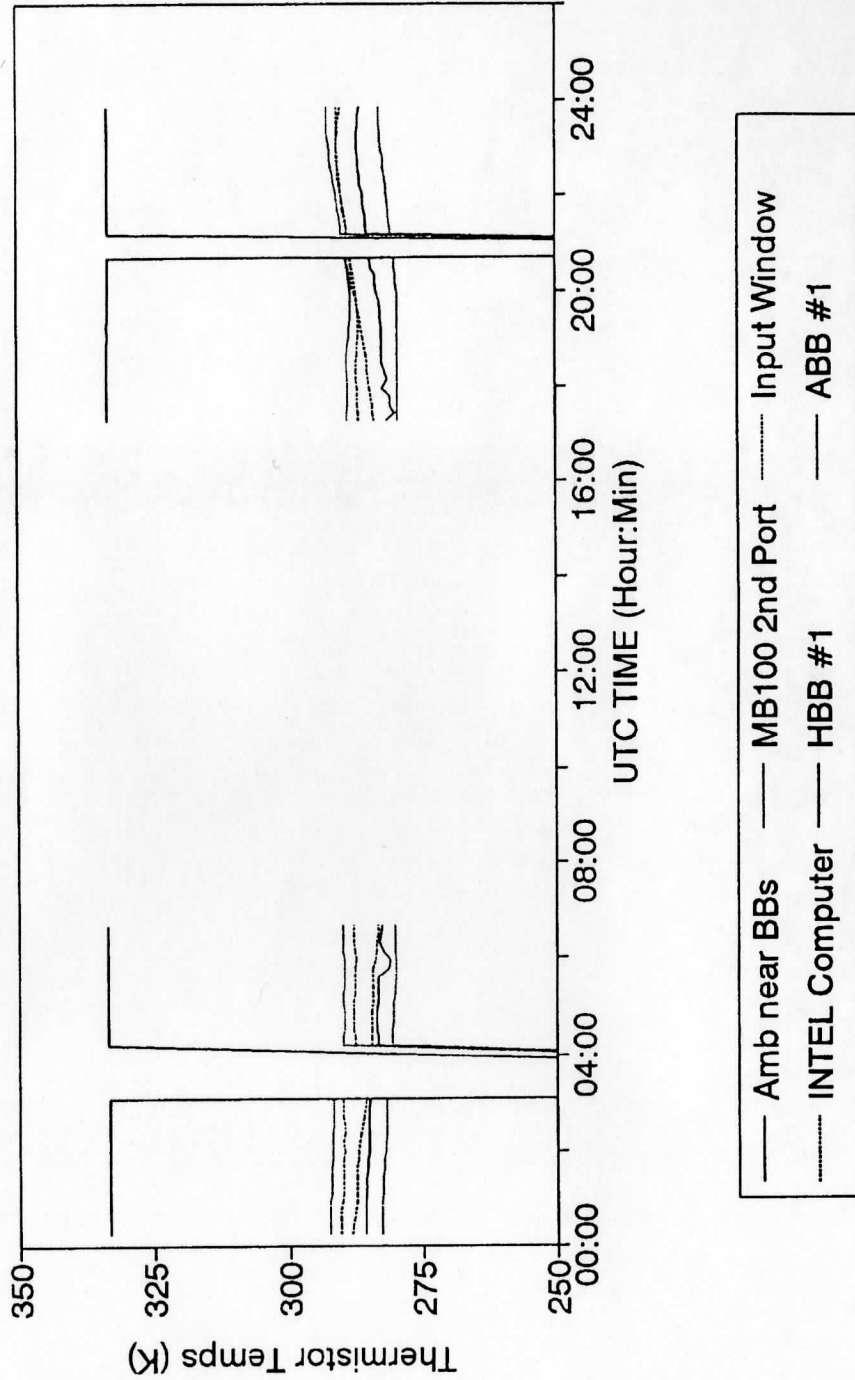
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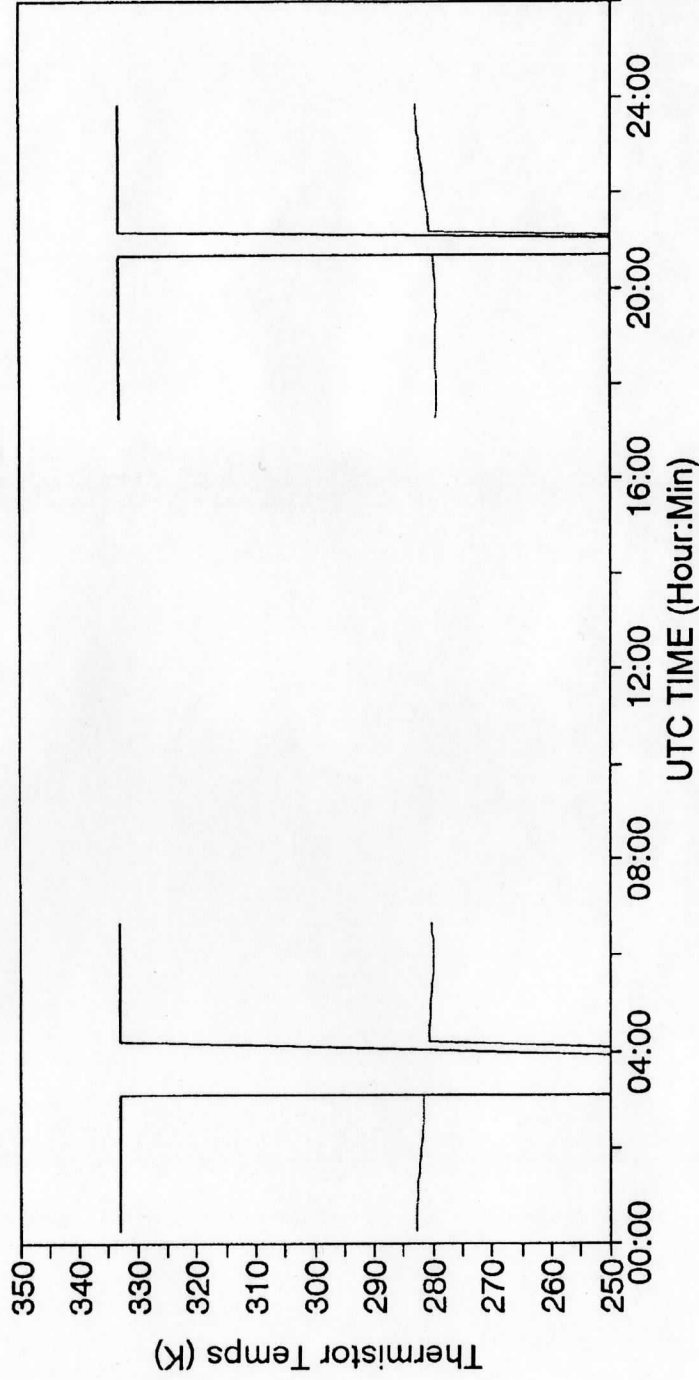


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AERI Housekeeping Summary  
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AERI Housekeeping Summary  
4 Dec 1991 (911204)



— HBB #2 — ABB #2