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XM-17530

PHASE ANALYSIS PROGRAM

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JEOL
Serving Advanced Technology

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XM-17530

PHASE ANALYSIS PROGRAM

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MANUFACTURER

JEOL Ltd.
1-2 Musashino 3-chome Akishima Tokyo 196-8558 Japan
Telephone: 81-42-528-3353
Facsimile: 81-42-528-3385

Note: For servicing or inquires, please contact your JEOL service office.

NOTATIONAL CONVENTIONS AND GLOSSARY

General notations

⚠ **WARNING :**	A potentially hazardous situation which, if not avoided, could result in death or serious injury.
⚠ **CAUTION :**	A potentially hazardous situation which, if not avoided, could result in minor injury or material damage. Material damage includes, but is not limited to, damage to related devices and facilities, and to acquired data.
– CAUTION – :	Points where great care and attention is required when operating the device to avoid damage to the device itself.
✍:	Additional points to be remembered regarding the operation.
☞:	A reference to another section, chapter or manual.
1, **2**, **3** :	Numbers indicate a series of operations that achieve a task.
◆ :	A diamond indicates a single operation that achieves a task.

CONTENTS

1 GENERAL

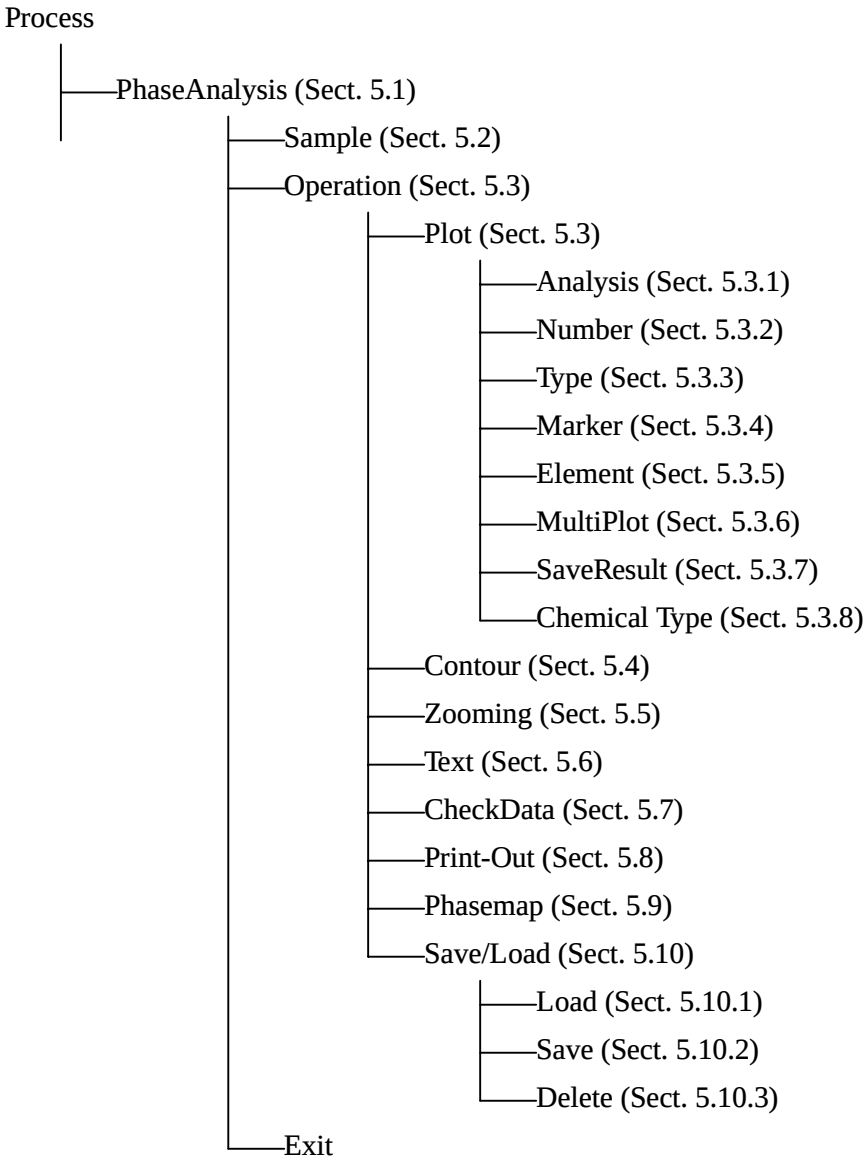
This is an application program that allows quantitative analysis, WDS semi-quantitative analysis, EDS semi-quantitative analysis, line analysis, map (area) analysis, WDS qualitative analysis, and particle analysis (optional) data to be displayed in one, two or three dimensions and the correlations between the constituent elements to be examined. Conventional software has displayed data with emphasis on the data format output from the instrument. In contrast, this application program processes data with emphasis on investigating the correlations between data, enabling you to interpret data in a different way, unlike with conventional display and processing software.
For example, once you designate an area on a plot, it can be saved as a phase map. Using the map-analysis display program, you can call up this phase map for comparison, allowing you to examine the correlations between the area on the plot diagram and the corresponding phase map in map analysis data.

2 SPECIFICATIONS

Data for processing:	Quantitative analysis data, WDS semi-quantitative analysis data, EDS semi-quantitative analysis data, line analysis data, map analysis data, WDS qualitative analysis data, and particle analysis data (requires optional software)
Data display format:	One-dimensional display (histogram), two-dimensional display (scatter diagram), and three-dimensional display (triangular diagram, 3-D spectrum)
Display data:	Measurement data (X-ray intensity, mass percent, atomic ratio), Stage X and Y coordinates), and results of user-specified calculations
Conditional data plotting:	Data within the range of specified maximum and minimum intensity values, and data within the range of a specified portion of an analyzed area
Grading of the element concentration display:	The element concentration (or X-ray intensity) can be graded into up to 8 different colors for display.
Grading of the dot-density display:	The dot-density can be graded into up to 8 different colors for display.
Data saving:	The plotted diagram pattern can be saved with a file name attached.
Phase map:	Up to 64 phases can be defined, and phase distribution data can be saved as map analysis data.

3 PROGRAM STRUCTURE

Structure of this program is as shown below.



4 OUTLINE OF MENUS/WINDOWS

4.1 "Phase Analysis" Window

Click on the Process menu icon in the EPMA Menu window to display a pull-down menu just below the icon (Fig. 1). The Basic window (Fig. 2) can be opened by selecting Phase Analysis from this pull-down menu.
Three buttons, Sample, Operation and Exit, are provided in this window. The functions of each button are as follows:

Sample:	Selects the sample data to be displayed for processing.
Operation:	Processes the selected sample data. When the Operation button is clicked, a sub-menu is displayed (refer to Sect. 4.2).
Exit:	Terminates the Phase Analysis program.

4.2 Operation Sub-menu

When the Operation button in the Basic window is clicked, a pull-down menu which includes the following items is displayed (Fig. 4).

Plot:	Opens the basic window. Several buttons are provided in this item for setting the plotting parameters.
Contour:	Grades the dot density or element concentration into different color for display.
Zooming:	Displays a portion of the plotted diagram in magnified scale.
Text:	Superimposes optional characters onto the displayed plot diagram.
Check Data:	Indicates the data value or density value of the designated point of the plotted diagram.
Print-Out:	Displays and prints out the plotting parameters and color grade values, etc.
Phase map:	Defines the phase and generates a phase map from map analysis data.
Save/Load:	Saves the plotted result pattern in the disk memory, or loads and displays a saved result.

4.3 Operation Window

Selecting Plot from the Operation menu that appears when you click on the Operation button in the basic window (Fig. 4) opens the Operation window (Fig. 5). Basic operations for displaying various data are carried out in this Operation window.

Analysis: Displays a menu from which you can select the type of analysis from qualitative, quantitative, semi-quantitative, line, map, and particle (optional) and also the type of data from mass percent, atomic concentration and X-ray intensity (refer to Sect. 5.3.1).

Number: Selects the sample number to be plotted. In all analyses except for map analysis, it is possible to select more than one sample number. In all analyses except for quantitative analysis, a specified portion of data can be plotted (refer to Sect. 5.3.2).

Type: Displays a menu from which you can select one-dimensional, two-dimensional or three-dimensional as the type of the plot. Straight-line or least-square fitting between data points is optionally available. Smoothing and dead-time correction are also optionally available for qualitative analysis, line analysis and map analysis (refer to Sect. 5.3.3).

Marker: Selects the type, size and color of the marker (refer to Sect. 5.3.4).

Element: Selects the variable to be plotted (refer to Sect. 5.3.5). One conditional element and its conditions (Maximum and Minimum values) can be specified (refer to Sect. 5.3.5.1).

Chemical Type: Color-codes and displays data for each chemical type when you determine the chemical type in particle analysis (optional) (refer to Sect. 5.3.8).

Multi Plot: Displays multiple qualitative or line analysis spectra in 3D (refer to Sect. 5.3.6).

Save Result: Saves the processed qualitative, line or map analysis data with a new data number (refer to Sect. 5.3.6). This is used for saving data with specified conditions of element concentration or for saving specified portion of data (refer to Sect. 5.3.7).

5 OPERATION

5.1 Selection of Phase Analysis Program

Clicking on the Process icon in the JEOL EPMA Menu displays a pull-down menu (Fig. 1). Selecting Phase Analysis from the pull-down menu opens the Phase Analysis basic window (Fig. 2). The results are displayed in the scaled frame at the left side, and display conditions and results of leveling are displayed in the parameter display area at the right side.

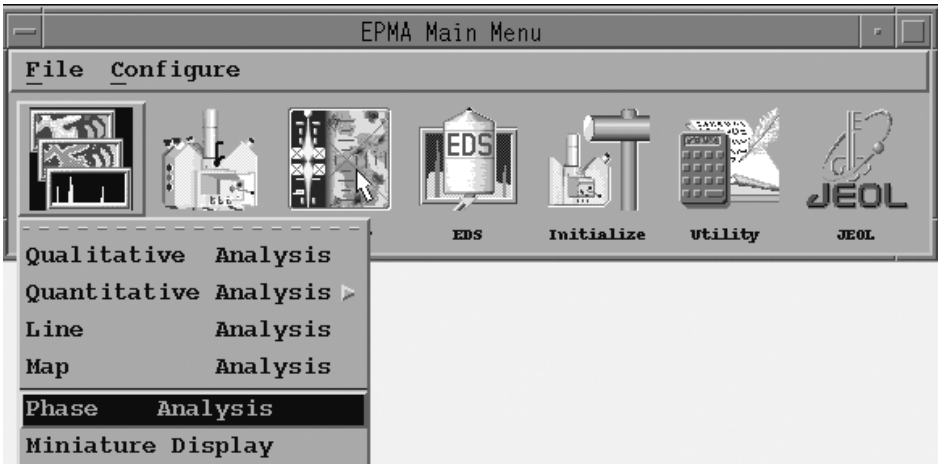


Fig. 1 EPMA Menu/Process pull-down menu

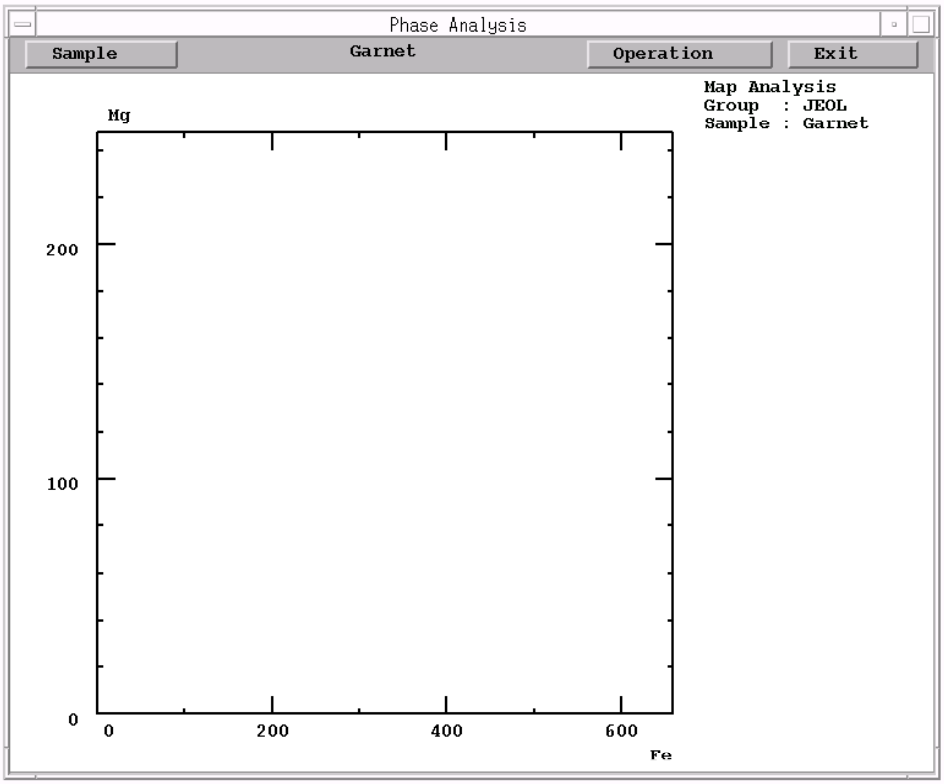


Fig. 2 Phase Analysis basic window

5.2 Specification of Group Name and Sample Name

Clicking on the Sample button in the Phase Analysis basic window displays the Select Sample window (Fig. 3). In this window, you can select the sample you wish to display. If many samples have been recorded, you cannot see all of them at first sight. In this event, use the scroll bar at the right side of the window and click on the Sorting Order–Name button or –Date button to sort the sample names and search for the desired sample in the sorted list. You can learn what analysis was implemented on the sample by seeing the asterisks in the columns from Qlw to Eds to the right of the Date column.
Here, Qlw denotes the qualitative analysis, Qnt the quantitative analysis, Lin the line analysis, Map the map analysis and Eds the EDS analysis.
If you wish to see a sample under another group, click on the Group button and select an appropriate group. Then search for the desired sample in the same manner as mentioned above.
Up to 10,000 analysis points are available for a sample. Incidentally, you can specify the analysis number using the Number button in the Operation window (Fig. 5).

The New button in the Select Sample window is disabled in phase analysis.

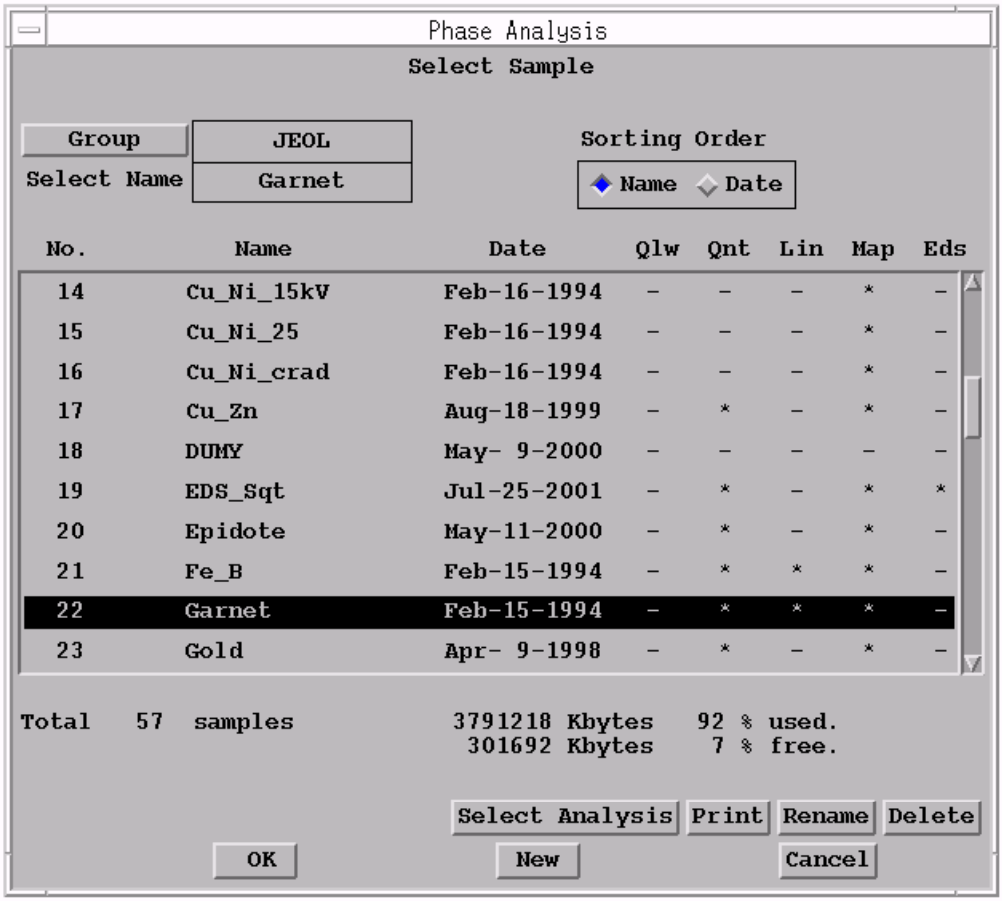


Fig. 3 Select Sample window

5.3 Setting Display Conditions

Clicking the Operation button in the Phase Analysis basic window displays the Operation menu (Fig. 4). Selecting Plot from the Operation menu displays the Operation window (Fig. 5). Described below are the methods for entering and specifying basic data display conditions.

New Plot:	Clears (erases) the current pattern, then plots the new data.
Overlay Plot:	Plots the new data on the current pattern. The new data is plotted in a new scale regardless of the scale of the last plot. To display the same scale, set the new maximum and minimum values in the “Element” window (refer to Sect. 5.3.5) to the same values as that for the last plot.
Re-plot:	Plots the same data again. This mode is used, for example, when changing the size of the window, as the size of the plotted pattern does not automatically adjust to the window size.
Stop:	During the plotting execution, this button is displayed in red. To stop the plotting during execution, click on this button.
Clear:	Clears (erases) the current plotted pattern.
Close:	Closes the plot window.

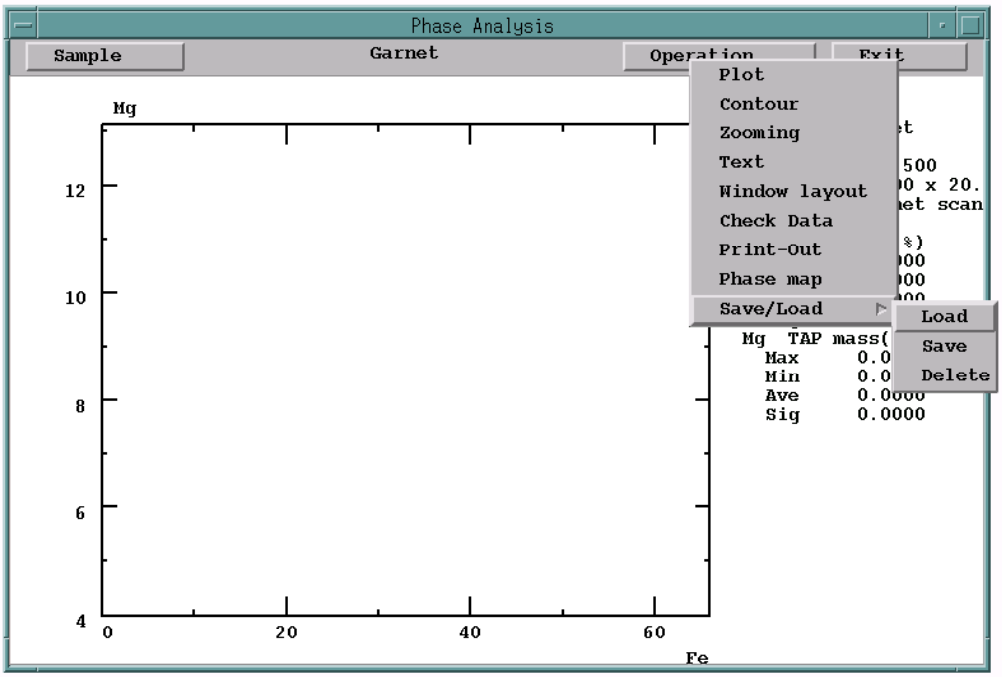


Fig. 4 Basic window/operation pull-down menu

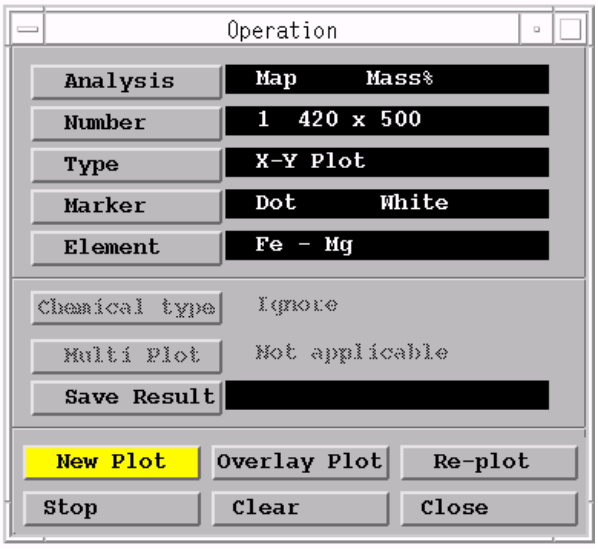


Fig. 5 Operation window

5.3.1 Analysis

Clicking on the Analysis button in the Operation window displays the Analysis window (Fig. 6). Select the type of analysis from the buttons under Analysis. Here, Qual denotes the qualitative analysis, Quant the quantitative analysis, Line the line analysis, Map the map analysis, WDS Semi. the WDS semi-quantitative analysis, EDS Semi. the EDS semi-quantitative analysis, and Particle the particle analysis. If there is a type of analysis that is not available with the present sample, the corresponding button is dimmed.

The buttons under Output enable you to select the type of output data. Here, Mass% denotes the mass concentration in percent, Atom the atomic concentration, and Intensity the X-ray intensity. You cannot select Mass% and Atom for qualitative analysis. In line and map analyses, if the A and B coefficients of the calibration factors that convert the X-ray intensity into the mass percent are set, you can select Mass% and Atom. Unless A and B coefficients have been set, Mass% and Atom cannot be selected even if you click on them; instead, the X-ray intensity data is displayed in this case. If you select Atom, the atomic concentration is calculated as the atomic ratio with respect to all measured elements.

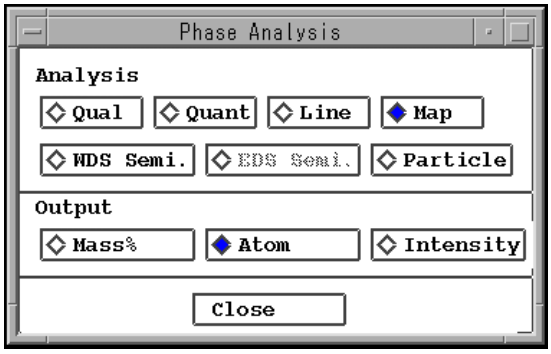


Fig. 6 Analysis window

5.3.2 Number

Clicking on the Number button in the Operation window displays the Select Sample window (Fig. 7 or Fig. 8). Fig. 7 is the window for qualitative analysis, semi-quantitative analysis, quantitative analysis, and line analysis. Fig. 8 is the window for map analysis and particle analysis. The scroll window at the top shows a list of the numbered samples that have been measured, comments, total mass percent, and stage coordinates for the quantitative analysis. (You can see hidden sample data using the scroll bar.) The sample numbers, comments, scanning conditions, and stage coordinates are displayed for qualitative analysis, line analysis, and map analysis. In map analysis, you can select only one sample from the displayed list while you can select multiple samples in qualitative analysis, line analysis, and quantitative analysis. You can use the Select All, Clear All, Single or Some button in the qualitative, line and quantitative analyses.
The Plotting Range box at the lower part is for inputting a display range. By default, all ranges are selected. If you intend to display a limited range, directly input its value using the keyboard. The comment box at the bottom is used for changing the comment in the parameter-display area at the right side of the basic window.

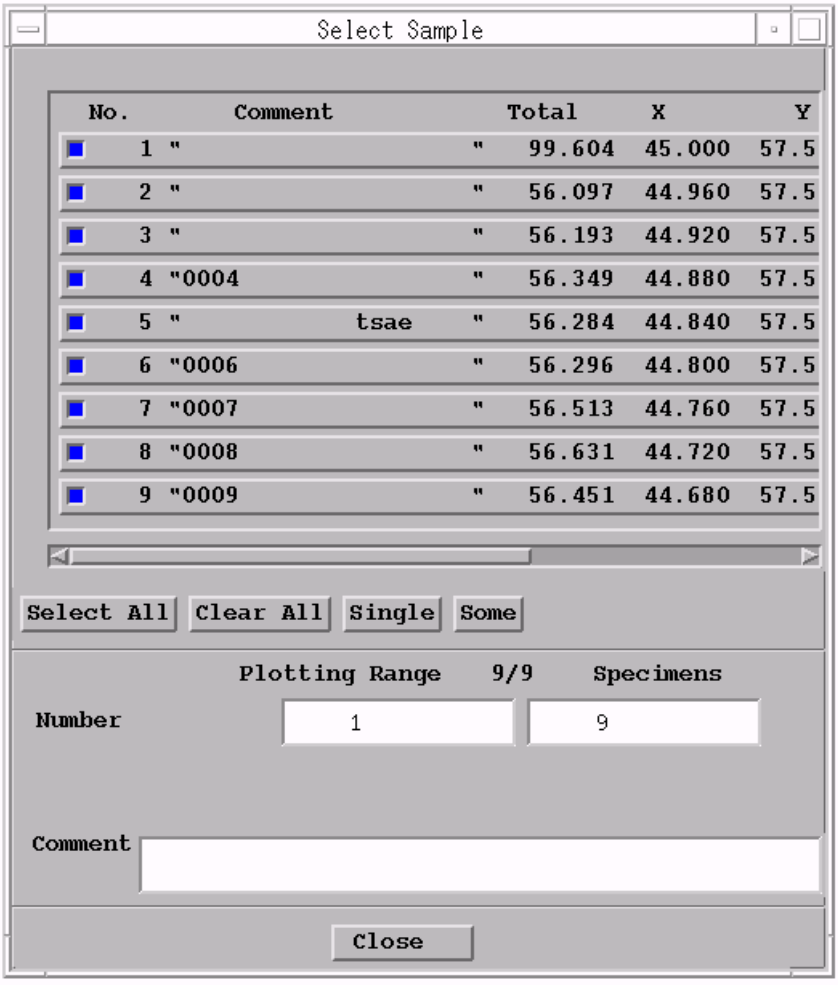


Fig. 7 Select Sample window (for qualitative, quantitative and line analysis data)

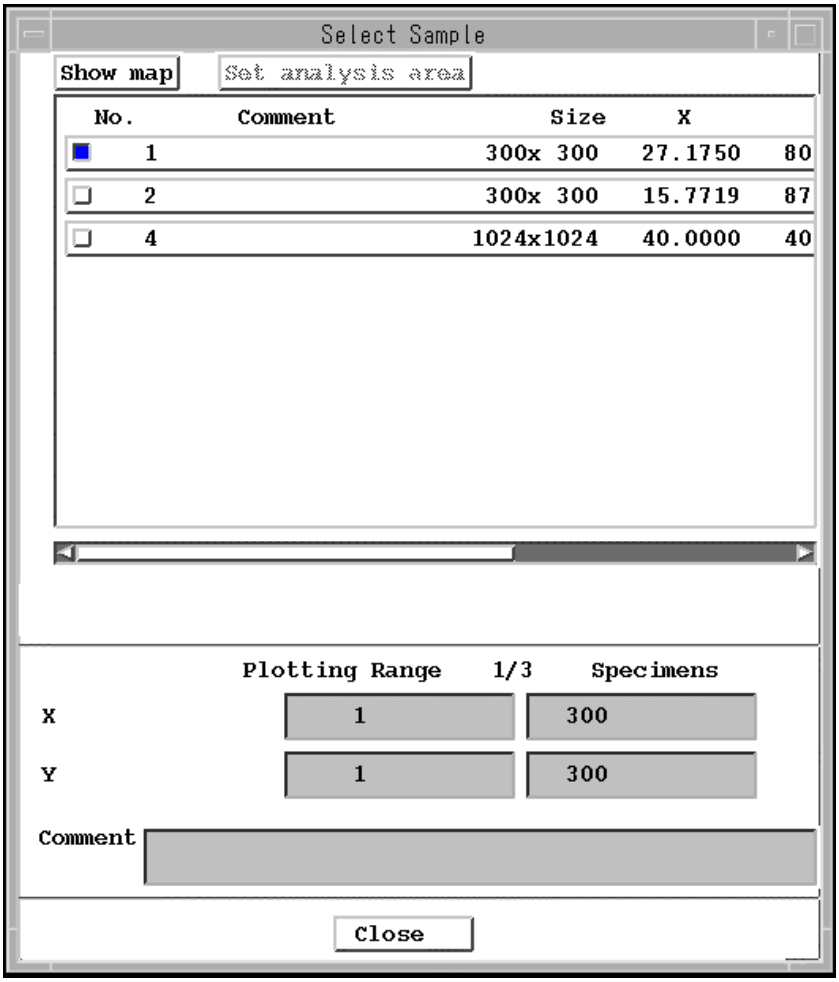


Fig. 8 Select Sample window (for map analysis data)

In the map analysis, the Show map button at the top of the Select Sample window displays one desired map. Clicking this button displays a list of measured elements in a different window. If you select one of them, the corresponding map image is displayed in another different window. Once a map image has been displayed, the Set analysis area button to the right of the Show map button is activated. Click on this button. You can specify the desired area on the displayed map image by dragging the mouse. You can now set this plotting data in the Plotting Range boxes in the Select Sample window.

5.3.3 Type

Clicking on the Type button in the Operation window displays the Plotting Type window (Fig. 9). Three buttons under Plot Type select the data-plotting format; clicking on Histogram, X-Y plane, or Triangle displays a 1-D histogram, 2-D scatter diagram, or 3-D triangular diagram, respectively. Fig. 10 shows examples of basic plotting formats.
This window also lets you specify the display process.

Draw Mesh:	Displays mesh (grid) lines along the basic axes of a data format.
Connect with lines:	Connects data points successively with straight lines. This is used for spectrum drawing or clarifying serial data numbers in a scatter diagram. This processing is effective in X-Y plane and Triangle, but is not selectable in areal analysis.
Least square fit:	After plotting data in a two dimensional diagram, straight line fitting by the least squares method is performed and the line is displayed on the diagram. The tangent and intercept of the line are indicated in the parameter display area of the “Phase Analysis” basic window. This is effective only when X-Y plane is selected.
Smoothing:	Data is indicated after smoothing processing. The smoothing method is 3-point moving averaging for qualitative and line analyses data, and 9-point simple averaging for areal analysis data. The smoothing function is not available for quantitative analysis data.
Dead time correction:	Dead time correction is applied on X-ray intensity data. This is effective when the X-ray intensity is very high. For information on dead time correction, refer to the instruction manual for quantitative analyses. As this correction has already been applied to quantitative analyses, it is not applicable on the software. Clicking on the Close button completes the selection.

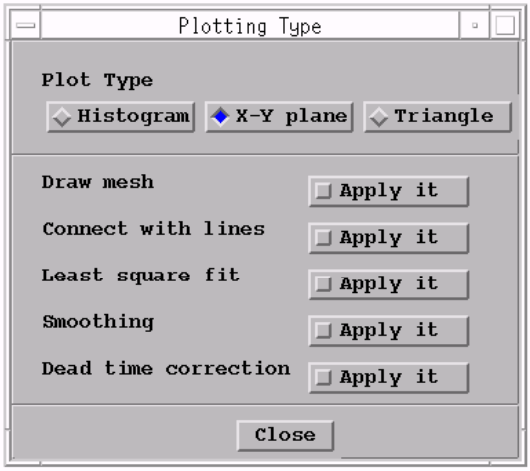
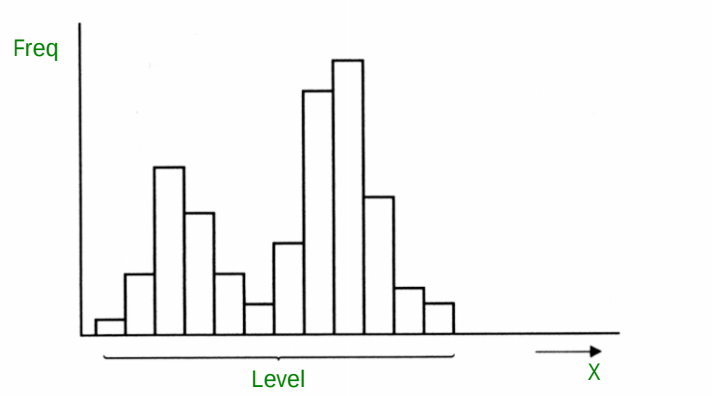
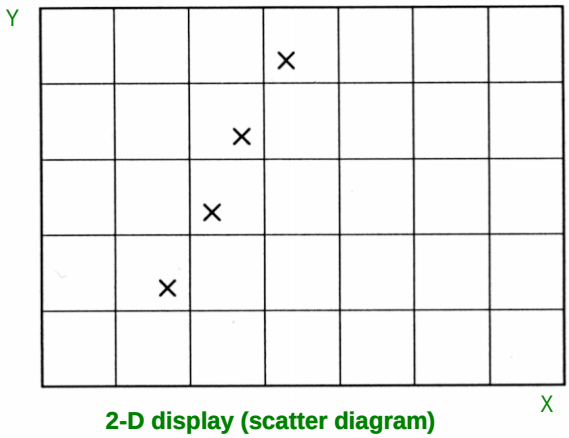


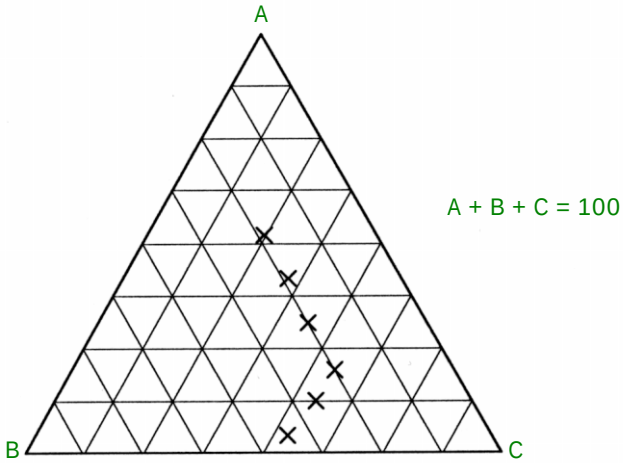
Fig. 9 Plotting Type window



1-D display (histogram)



2-D display (scatter diagram)



3-D display (triangular diagram)

Fig. 10 Three basic plotting formats

5.3.4 Marker

Clicking on the Marker button in the Operation window displays the Marker window (Fig. 11). Select a shape for the marker for displaying analysis points. The choices are Dot, Plus, Asterisk, Circle, Cross Triangle, Square, Diamond, and Number. (Number is not acceptable in map analysis.)

The buttons under Color in this window enable you to select a color for the marker from Black, Blue, Cyan, Green, Yellow, Red, Magenta, and White.

The buttons under Size in the window enable you to select a size for the marker from Small, Middle, Large, and Very Large. When you select Dot as the Marker shape, Size has no meaning because the dot size is always one pixel.

Since a great many data points are plotted in a map analysis, we recommend Dot for the shape of the marker. Since the data number often has a special meaning in a quantitative analysis that does not usually have so many data points, it may be useful to select Number as Marker for the quantitative analysis, for example. We recommend that you try displaying some plots with various marker symbols, colors, and sizes while considering these factors.

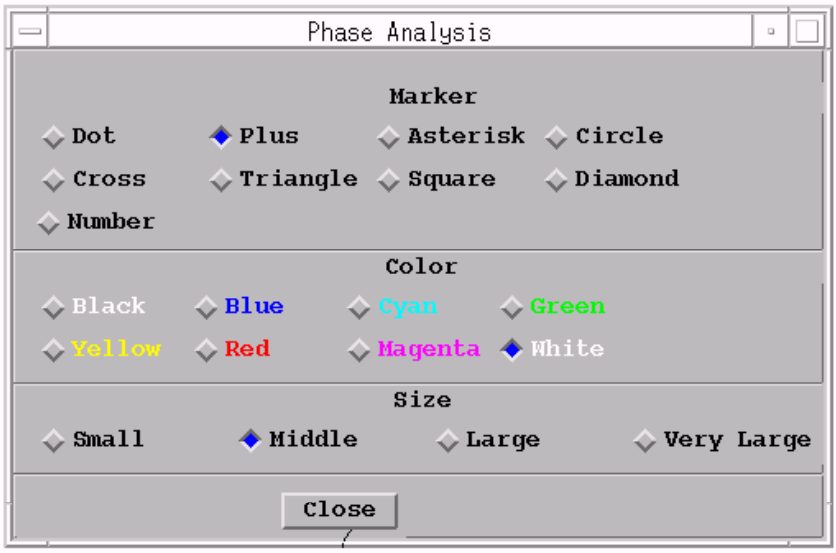


Fig. 11 Marker window

5.3.5 Element

■ Selection of normal data

Clicking on the Element button in the Operation window displays the Elements window (Fig. 12, Fig. 13 or Fig. 14). Fig. 12 shows a one-dimensional input window, Fig. 13 a two-dimensional input window, and Fig. 14 a three-dimensional input window. In the scroll window at the top of the Elements window you see the names of the measured elements, those of the coordinate axes and so on. Below the scroll window, you see the Element box in which you can input an element name.

Fig. 12 is an example of inputting data in a single-axis (X) display, Fig. 13 an example of inputting data in a two-axis (X, Y) display, and Fig. 14 an example of inputting data in a three-axis (A, B, C) display. In the example of Fig. 12, Freq and Level input boxes are provided; Freq represents the maximum number of data points on the vertical axis in the histogram and Level the number of divisions on the horizontal axis in the histogram. The default value for Freq is one tenth of the total number of data points. That for Level is 100 or an actual X-ray intensity value if the X-ray intensity is less than 100. The maximum value that can be set is 200.

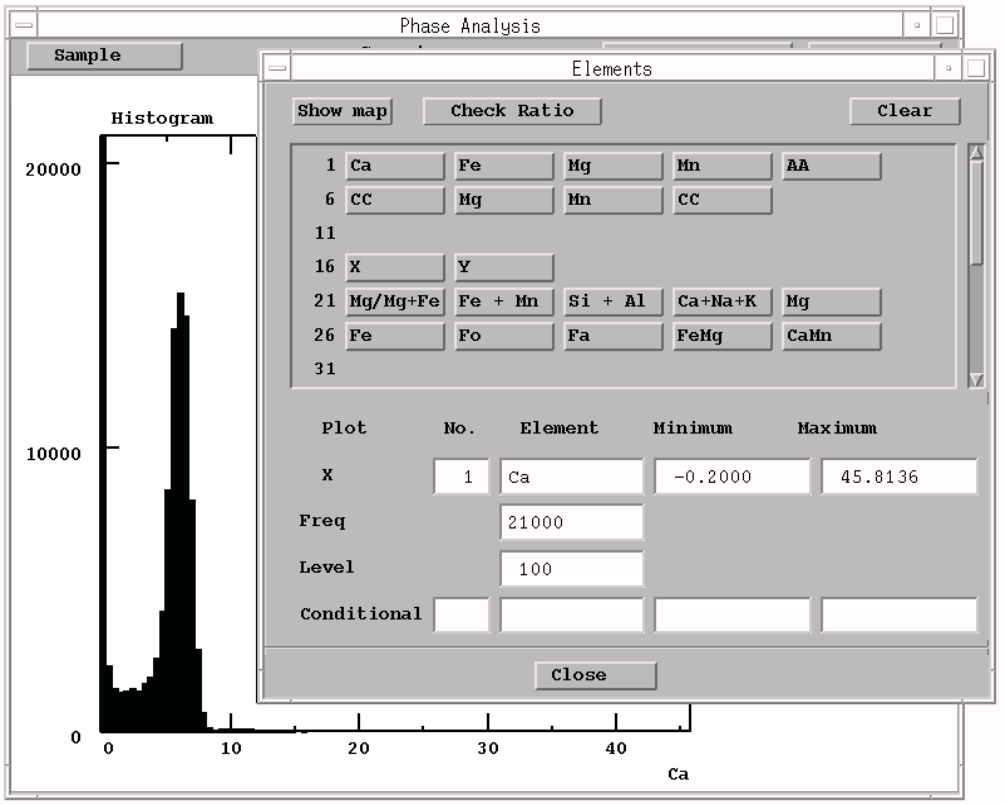


Fig. 12 Elements window in one-dimensional display

Three methods are available for selecting data. These are 1) clicking on an element name button that corresponds to the data number (the numbers increment from left to right) in the scroll window, 2) entering, using the keyboard, in the No. input box, the data number for an element you wish to search, and 3) entering the element name in the Element input box. When you select data successively using method 1, the designated data number is entered in order from the top to the bottom in the Element input box.

If you intend to delete all of your entries from the Element input box, click on the Clear button at the top right of the Elements window.
In the Minimum and Maximum input boxes under the scroll window, the minimum and maximum values based on the selected data output type are automatically displayed. To change these values, place the cursor in the corresponding input box and input a new value using the keyboard.

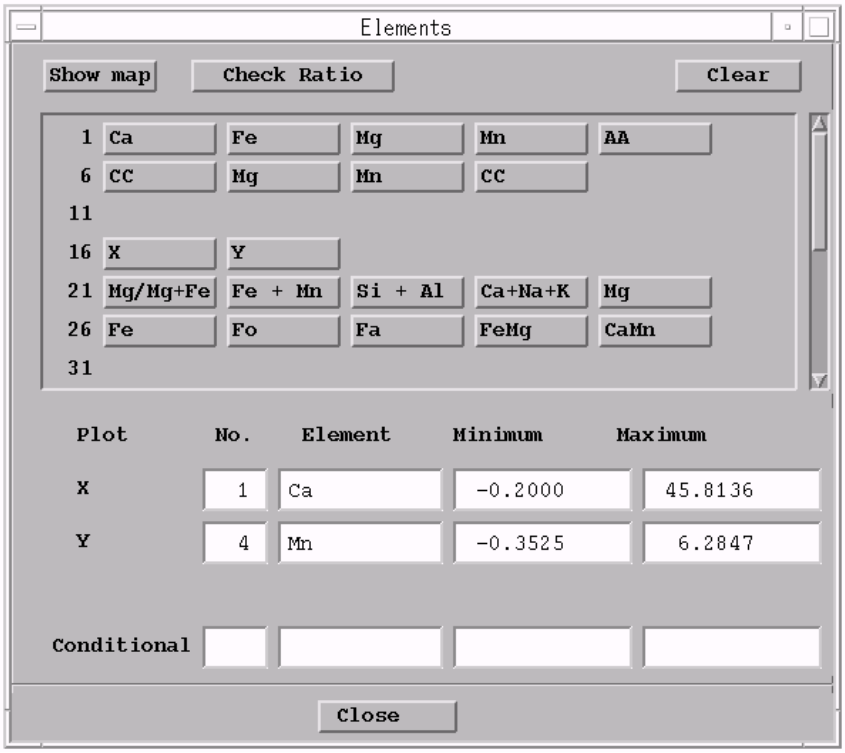


Fig. 13 Two-dimensional Elements window

In the three-dimensional display (triangular diagram), the minimum and maximum values of the selected data are not raw data but data normalized to 100-percent. By default, the minimum and maximum values are 0 and 100, respectively. If you have changed minimum and maximum values for one of three axes, the values for the two other axes are calculated automatically. This is because a triangular diagram is always displayed in the shape of an equilateral triangle.
Conditional input boxes at the bottom are for specifying the data of interest and giving it new conditions. Only data points meeting the new minimum and maximum values are plotted and actually displayed. This function is useful for plotting part of data selectively.

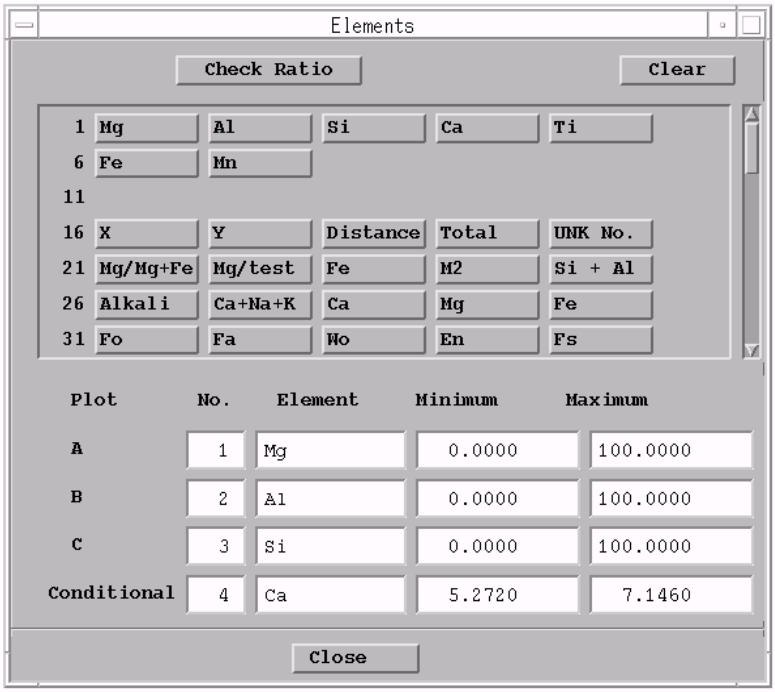


Fig. 14 Three-dimensional Elements window

Data displayed using special units

You can display data in the coordinates that use special units on the display axes instead of using ordinary measured X-ray data (Fig. 15).

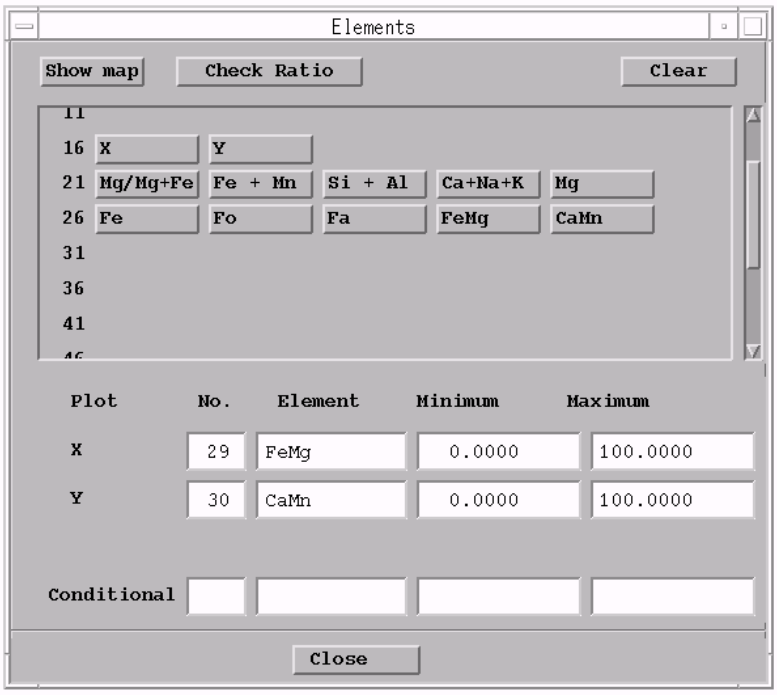


Fig. 15 Selection of special units on the display axes

For qualitative analysis, you can specify the following special axis labels on the display axes.

mm:	Spectrometer position in mm
nm:	X-ray wavelength in nm
Distance:	Distance from the spectrometer starting position in mm
Data_No.:	Serial Number of measured data starting with 0

For line analysis, you can specify the following special axis labels on the display axes.

x:	Stage X coordinate in mm
y:	Stage Y axis coordinate in mm
Distance:	Distance from the spectrometer starting position in mm
Data_No. :	Serial Number of measured data starting with 0
Calculation value:	Result of user-defined calculation formula (refer to “Check Ratio”)

For map analysis, you can specify the following special axis labels on the display axes.

x:	X-axis pixel value
y:	Y-axis pixel value
Calculation value:	Result of user-defined calculation formula

For quantitative analysis, you can specify the following special axis labels on the display axes.

x:	Stage X-axis coordinate in mm
y:	Stage Y-axis coordinate in mm
Distance:	Distance from the first analysis point
Total:	Total mass percent
UNK_No. :	Quantitative analysis number
Data_No. :	Serial Number of measured data starting with 0
Calculation value:	Result of user-defined calculation formulas

The above-mentioned special axis labels for data display differ from each other even if they have the same name.

Check Ratio

You can specify your own calculation formula as display data. Click on the Check Ratio button in the Elements window to open the Check Ratio window. Fig. 16 is a Check Ratio window (identified as summary.ratio) for the quantitative analysis, and Fig. 17 is a Check Ratio window (identified as map.ratio) for the line and map analyses. The contents of these windows are basically the same.

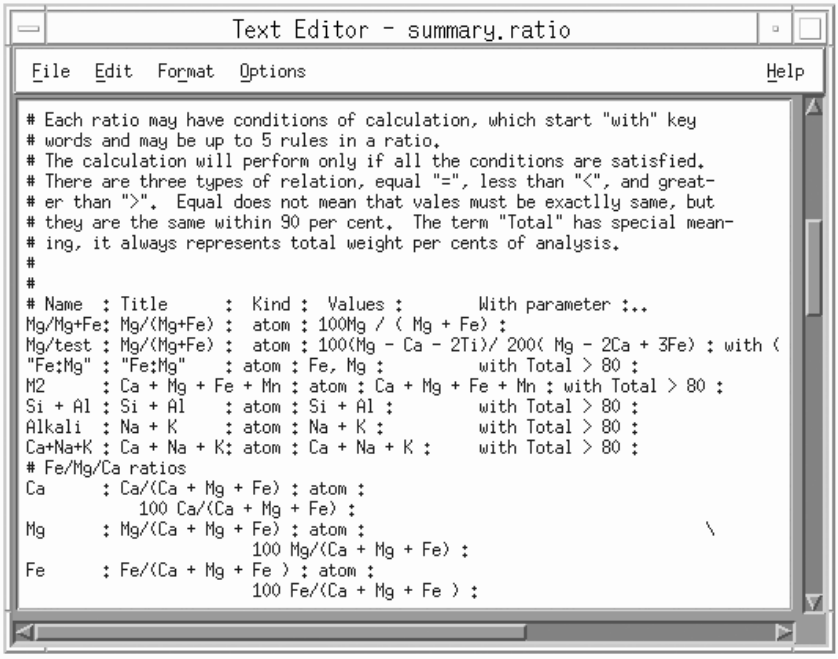


Fig. 16 Check Ratio window for the quantitative analysis

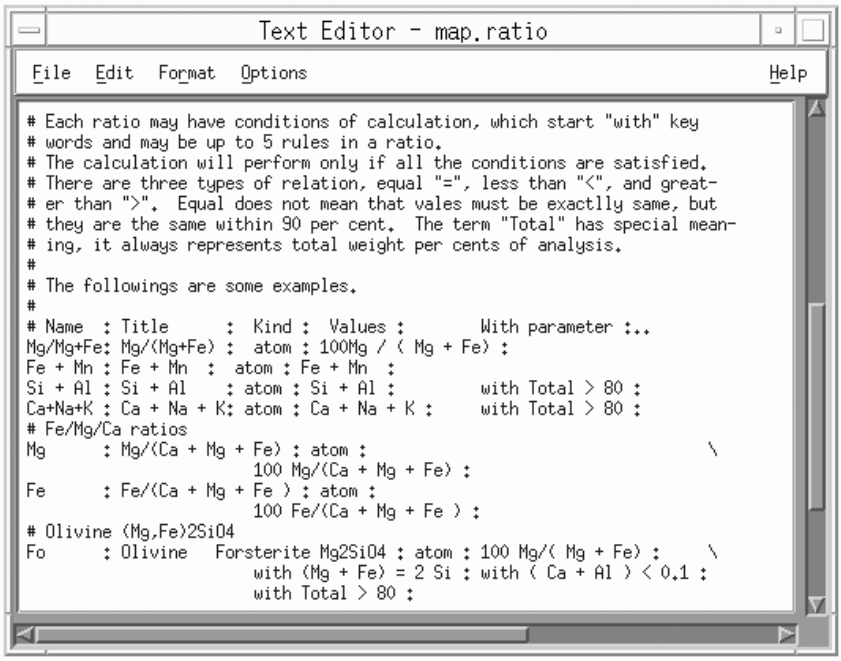


Fig. 17 Check Ratio window for the line and map analyses

You can enter your own calculation formula using the text editor.
The rules for defining the formula are given below.

- Lines beginning with # are comment lines and do not influence calculation.
- In principle, one formula is written on one line. However, when the formula is long enough to go off a line, append a back slash (\: a ¥ may be printed depending on the keyboard) to the end of the line, and you can continue the formula over multiple lines.
- The sequence for formula entry is as follows:

```
Name : Comment : Data type : Formula : Condition 1 : Condition 2 : ...
```

Name:	Up to eight characters. The name displayed in the Elements window should be used.
Comment:	Up to 50 characters. You can use Comment as a memorandum.
Data Type:	Enter wt for mass percent and atom for the atomic concentration.
Formula:	Enter the calculation formula you intend to actually use in calculation. Four operations (addition (+), subtraction (–), multiplication (*), and division (/)) and single parentheses () can be used. For example, an input in the form 100Mg/(Mg+Fe) is for calculating the percentage of Mg contained in a sample of Fe and Mg. Incidentally, 100Mg is the same as 100*Mg. When an element in a formula does not actually exist in the measured data, the element is neglected.
Condition:	After the entry of a formula you can further enter up to five conditional formulas. This sort of conditional formula enables you to abstract and calculate only the desired phase. (You need not input any conditional formulas.) A conditional formula is an expression starting with the “with” parameter; the left-side member is connected with the right-side member via a relational symbol (>, <, or =). The = symbol means not that two values are not exactly the same but that they are between 90% and 110% of each other. The Total parameter can be used in a conditional formula. Total represents the sum of the quantitative results (Mass% Total).

The following is an example of calculation formulas followed by conditional formulas. The example is for calculating enstatite (MgSiO3), a constituent of pyroxene.
Note that there is no back slash at the end of the last Total equation.

```
#Pyroxene (Ca,Mg,Fe) SiO3
En:Enstatite:atom:\
100Mg/(Ca+Mg+Fe):\
with (Ca+Mg+Fe)=Si:with 3(Ca+Mg+Fe)=O:\
with Total>80:
```

In the above expression, pyroxene is shown by a general formula, (Ca, Mg, Fe) SiO3, and is assumed to be composed of three constituents, wollastonite (CaSiO3), enstatite (MgSiO3), and ferrosilite (FeSiO3). The name of the calculation formula is En, and it is calculated as the atomic rate. This calculation is implemented in terms of the formula 100Mg/(Ca+Mg+Fe) only when 1) the sum of the number of Ca, Mg, and Fe atoms equals to the number of Si atom, 2) three times that sum is equal to the number of O atoms, and 3) the total mass percent is more than 80%.

5.3.6 Multi Plot

Click the Multi Plot button of the Operation window, to display the Multi Plot window (Fig. 18). Parameters for displaying spectra in a 3D diagram are set in this window.
This item becomes effective only when multiple sample numbers are selected in a qualitative analysis or line analysis. In this case, it is assumed that the measurement conditions for each data are all identical. If the conditions are different, the displayed result may be incorrect.

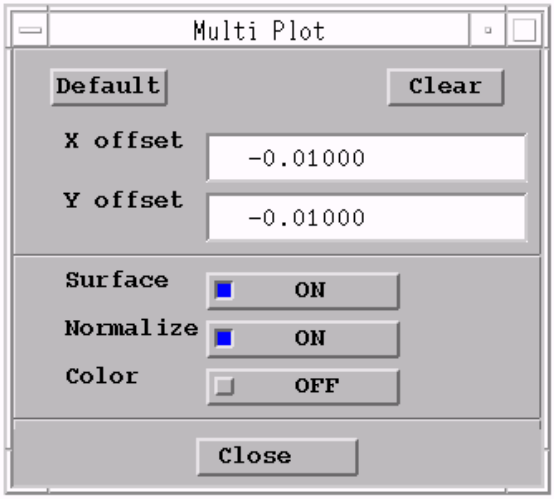


Fig. 18 Multi Plot window

Click on the Default button, to select the default condition of 3D indication. To delete the conditions, click on the Clear button.

X offset: Specifies the interval between spectra as a relative value with the full length of the X-axis assumed to be 1. A positive value will be graphed on right side of the X-axis, a negative value will be graphed on the left side. The lateral angle becomes larger with the entered value.

Y offset: Specifies the offset value between spectra as a relative value that the full height of the Y-axis assumed to be 1. A positive value will be graphed on the front side of the Y-axis, a negative value will graphed on back. The azimuth angle becomes larger with the entered value.

Surface: When this button is set to ON, the parts of the spectrum hidden by the foreground spectrum are not displayed. The effect of this is that the spectra is seen as if it is a solid surface.

Normalize: Normalizes each Y-axis scale with the maximum intensity value of each spectrum. This is effective for comparisons of spectra.

Color: Grades the Y-axis scale with colors. This is effective to emphasize a spectral difference in the height direction.

5.3.7 Save Result

This function extracts the part of the data that meets the specified conditions, and saves the data under a new number.
If a Conditional element was specified, if the data range for plotting was limited, or if the phase map function was executed (refer to Sect. 5.9), not only will the currently displayed element's data be saved, but also all other element's data are saved at the same time if they meet the same conditions.
In this case, data at the points not conditioned are assumed to be "0".
This function is available when only one sample is selected for processing in qualitative, line and map analyses.
Click on the Save Result button in the Operation window, to open the Save Result window (Fig. 19).
When the Not saved button is clicked, no data saving is performed.
When saving, click on the Plot & save button, then enter Number and Comment.
The entered number can range from 1 to 9999. If the entered number has already been registered, the warning message "This number is present!" is displayed. If you do not want to overwrite the data, change the number.

A comment on the current sample is indicated in the Comment box.
If the comment is changed, the new comment is saved with the data.

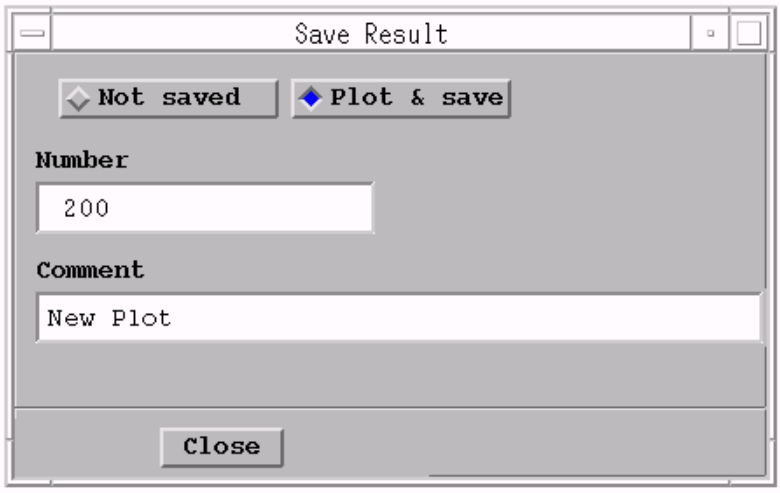


Fig. 19 Save Result window

5.3.8 Chemical Type

When you determine the chemical type in fully automatic particle analysis (using optional software), you can color-code and display data for each chemical type. Clicking on the Chemical type button in the Operation window displays the Chemical Type window (Fig. 20). The chemical types that appear are listed in the order of frequency of appearance (from high to low). If you wish to display the specified chemical type, click on the Select chemical type button, then select only the corresponding chemical type. If you intend to display data color-coded for each chemical type, click on the Colored by chemical type button to display the Colored by chemical type window (Fig. 21). By default, colors are assigned in the order of frequency of appearance. To change the default settings, enter, using the keyboard, the numbers allocated to the chemical types or the chemical types, in sequence from the top to bottom.

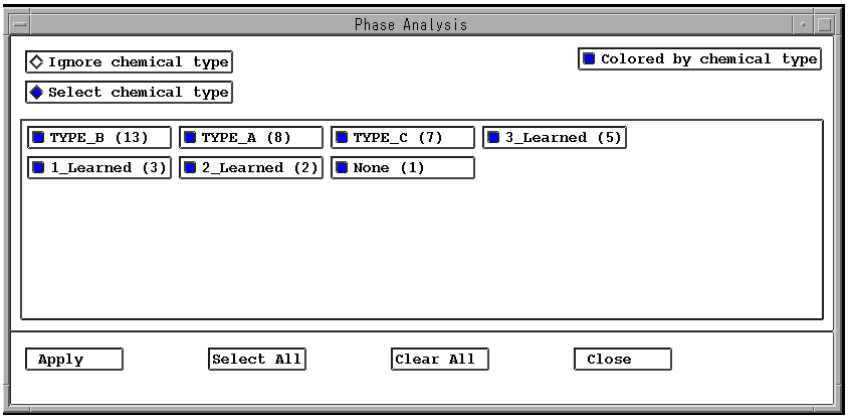


Fig. 20 Chemical Type window

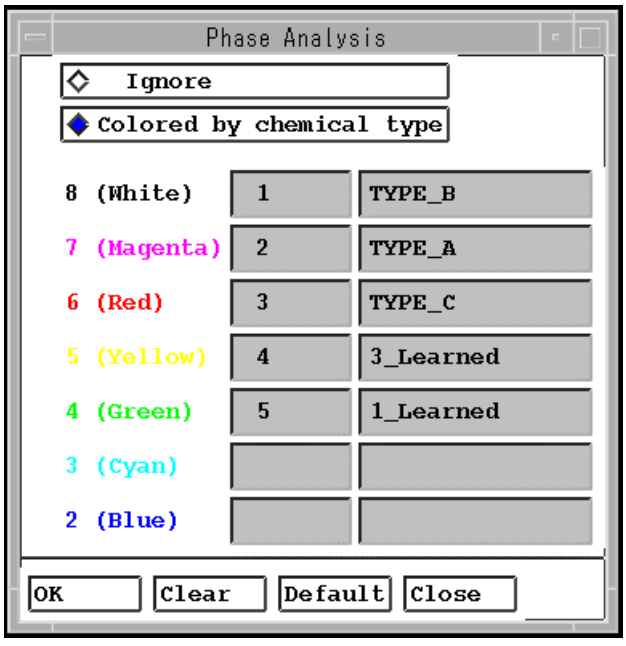


Fig. 21 Colored by chemical type window

5.4 Contour

Dots on a scatter diagram are displayed in different colors according to the dot density grades (Contour), or according to the specified element's concentration grades (Element). Up to 8 colors for 8 grades can be designated. Contour is applied only to the scatter diagram that is already plotted. But in the case of Element, color grading can also be done before plotting.
Selecting Contour from the Operation menu displays the Level windows (Fig. 22).

Contour window Element window

Fig. 22 Level windows

Ignore: The Contour function (Contour or Element) is not performed.

Contour: Clicking on this button displays grade input boxes for White to Black. Each grade level can be set as a % value from the key board. Values between 0% and 100% can be set. The default settings are the values set the last time this function was used.
It is recommended that you check the density by the Check Data function prior to grade setting.

Element: Indicates another specified element's concentration grades in different dot colors. Clicking on this button displays the element boxes and grade input boxes for White to Black. Enter the atomic symbol or element number in the Element and/or the Number boxes. The concentration grade for each color can be entered from the key board.

The default levels for the colors come from equally dividing the differences between the maximum and minimum concentration value by eight.

Clicking on the Equal width button at the top left of the window divides equally the difference between the values in 8 (White) and 0 (Black) and allocates values for each color level.
Clicking on the Clear button at the top right of the window cancels all settings.
This window also has the following execution buttons:

Apply:	Executes plotting according to the set conditions.
Stop:	Halts the execution.
Reset:	Cancels the Contour or Element indication and returns to the original display.
Close:	Closes the window.

5.5 Zooming

Select Zooming from the Operation menu to display the Zooming window (Fig. 23).
The currently plotted elements are indicated on the left side of the window. The plotted data range for each element is indicated on the right side of the window.
To magnify (zoom) a portion of the plotted diagram, frame the portion to be magnified by dragging the mouse on the diagram display area, or by entering values in the Minimum and Maximum boxes using the key board. Then, click on the Apply button.
This window has the following execution buttons:

Apply:	Executes the function according to the set conditions.
Stop:	Halts the execution.
Reset:	Cancels the magnifying function and returns to the original display.
Close:	Closes the window.

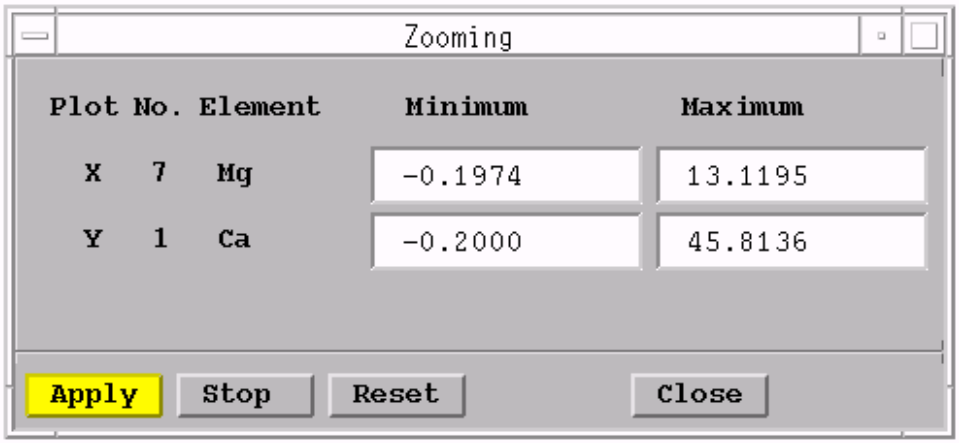


Fig. 23 Zooming window

5.6 Text

Select on Text from the Operation menu, to display the Text window (Fig. 24).
Enter an optional comment in the Text box, and specify the display color and character size. Then, position the marker in the diagram display area at the point where the first character of the text is to be displayed, and click the mouse button. A cross cursor will appear at the marker point. By clicking on the Apply button, the cross cursor disappears, and the text is displayed starting from this point.

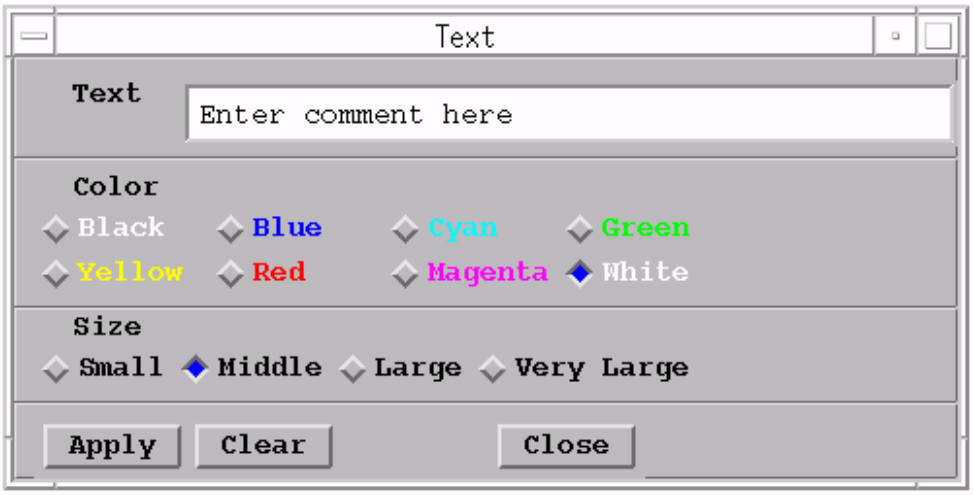


Fig. 24 Text window

The following execution buttons are provided in this window.

Apply:	Displays the text at the designated position on the diagram display area.
Clear:	Clicking on this button erases the entered text. Clicking on it again erases another text. Repeat this step if several texts have been entered.
Close:	Closes this window.

5.7 Check Data

Select Check Data from the Operation menu to display the Check Data window (top right in Fig. 25). The sample number (for quantitative analysis), pixel number (for qualitative, line and map analyses), data values, and dot density are displayed in this window. In the parameter area of the Basic window (bottom right in Fig. 25) are displayed the measured values of the constituent elements.

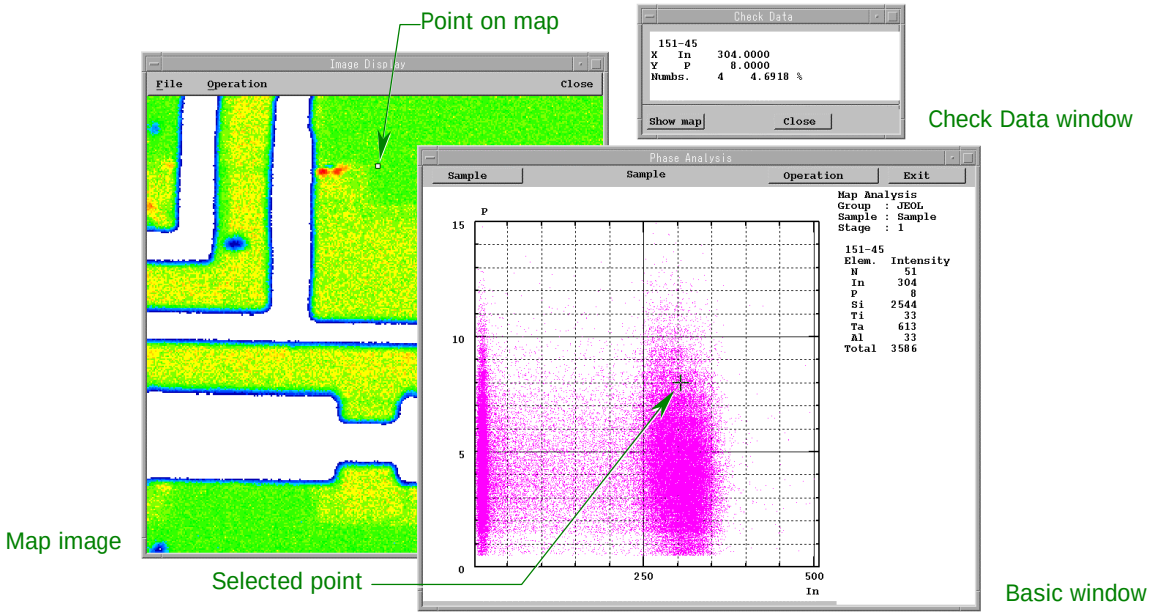


Fig. 25 Check Data window, Basic window and map image

In a map analysis, when you select any desired point on the image shown in the Basic window using the mouse, a cross appears there and data at that point is displayed in the Check Data window. When you click on the Show map button here, a map image based on the data displayed in the Check Data window appears as shown on the right side of Fig. 25. In this map image, you see the point (marked in black) that corresponds to the cross. Conversely, if you select any desired point in the map image using the mouse, you see the corresponding point marked with a cross in the Basic window.

Operation using the mouse pointer is limited in the Zooming, Text, Check data, and Phase map windows. If any one of these windows is being used, the rest of them cannot be used simultaneously.

5.8 Print-Out

Select Print-Out from the Operation menu to display the Print-Out window (Fig. 26). Plotting conditions and results are displayed in this window. The contents of the window can be printed.

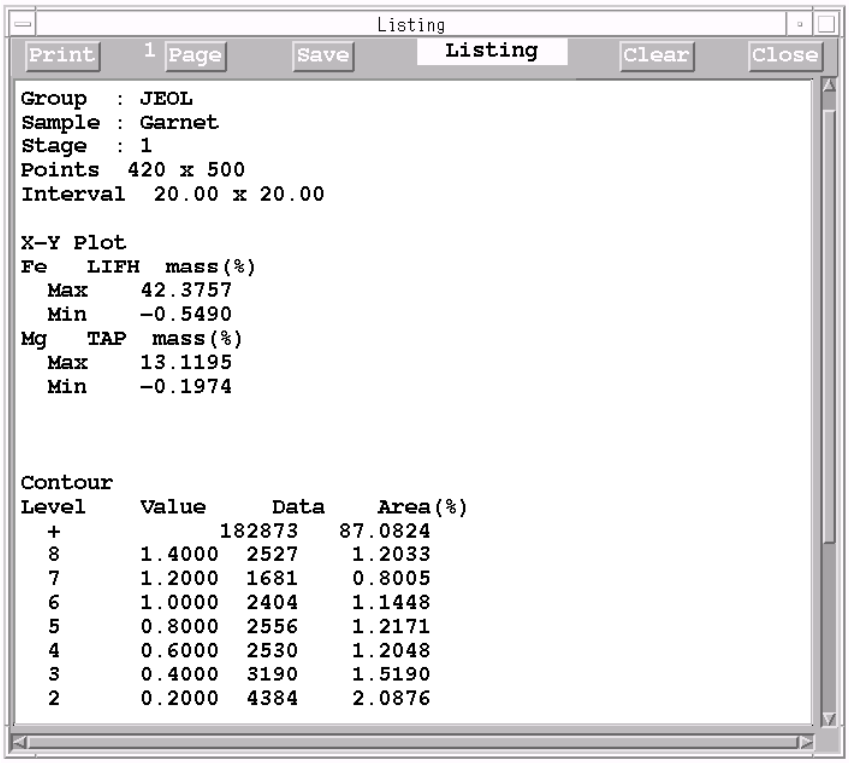


Fig. 26 Print-Out (x text) window

The contents of this window are Group name, Sample name, Number, Comment, Plot type, Maximum, Minimum, Average, and Variance of the plotted data.

The following can be displayed in addition to the above:

If Histogram is selected, division (level) and frequency of the histogram (refer to Sect. 5.3.5).
If Least squares fit is selected, the formula of the straight line, tangent and intercept are displayed (refer to Sect. 5.3.3).
If Contour/Element is selected, grade levels of Contour or Element, and data frequency for each grade are displayed (refer to Sect. 5.4).
If Phase map is selected, the name of the phase and data frequency for each phase are displayed (refer to Sect. 5.9).

are indicated in the window.

Furthermore, any optional comment can be added or deleted at the position pointed at with the marker.
This window has the following execution buttons:

Print:	Outputs contents of the display to the printer.
Save:	Saves the contents of the display in a disk with the file name.
Clear:	Deletes the contents of the display.
Close:	Closes the window.

5.9 Phase Map

Phase map is a very useful function for map analysis.
Fig. 27 shows the procedure for phase mapping.
Specify two (or three) elements for the phase component, select the data for the specified elements from the map analysis data and plot them on a two-dimensional (or three-dimensional) scatter diagram. The phase area is defined on the scatter diagram. Only the data that is within the defined phase area on the scatter diagram is stored in the file named “CC”.
The data in the “CC” file can be displayed as a phase map by the map analysis display program.

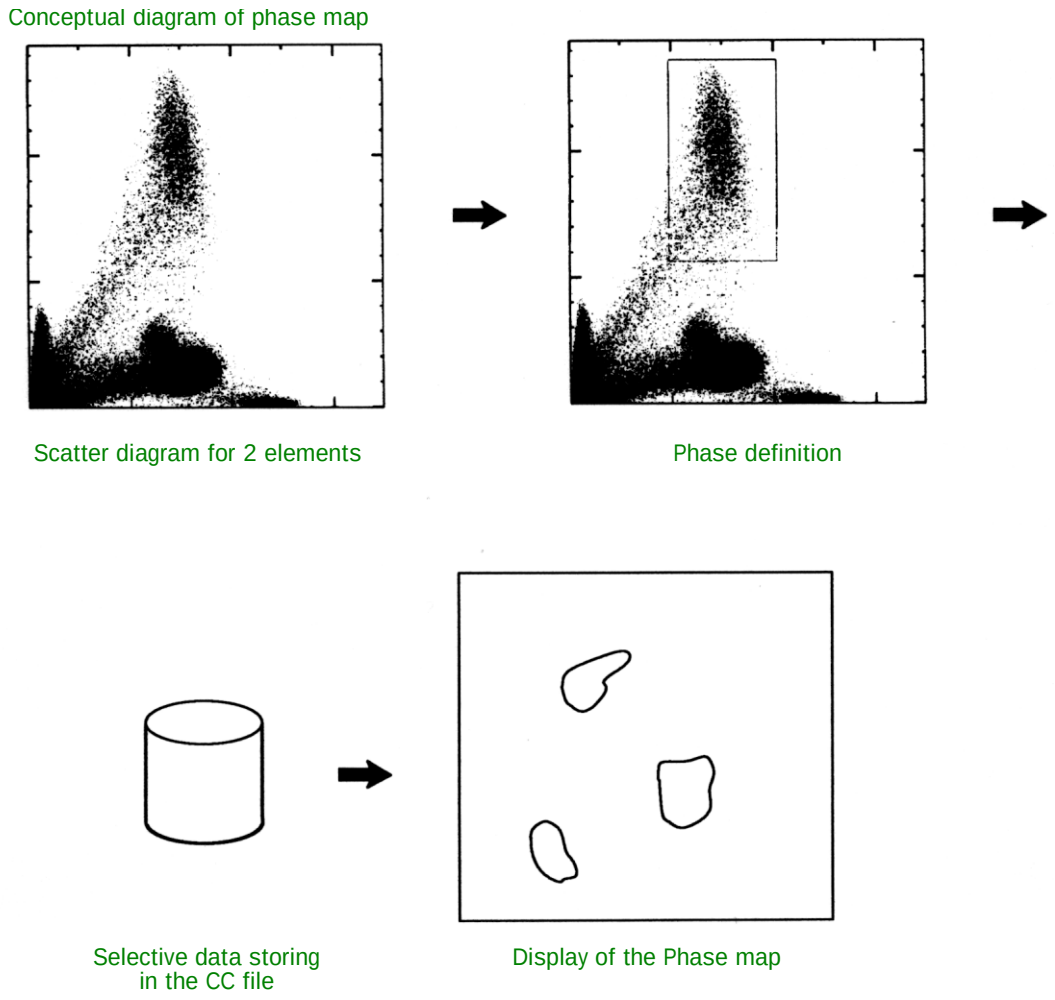


Fig. 27 Procedure for Phase mapping

5.9.1 Phase selection

Select Phase map from the Operation menu, to display the Phase Map window (Fig. 28).

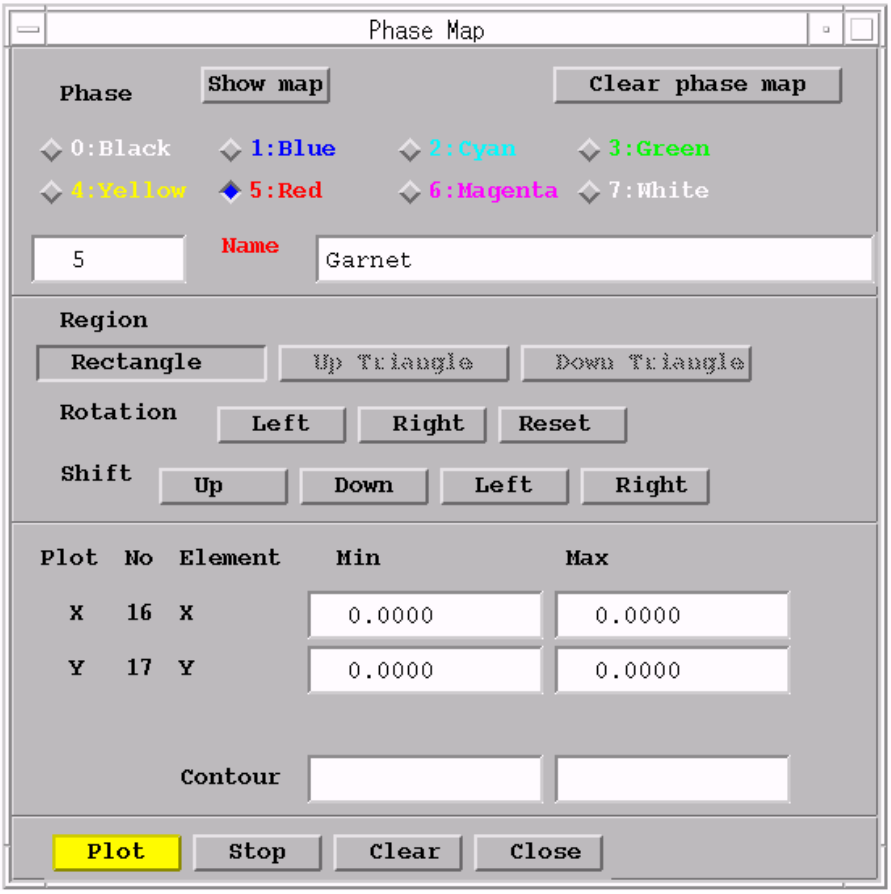


Fig. 28 The Phase Map window

The name and indication color of the defined phase are designated in the Phase input box displayed in the upper part of the Phase Map window. Up to 64 phases can be defined. A phase number and phase name are attached to each phase.
The phase number corresponds to the color button number indicated in the upper part of the window. You can click on a color button or enter a number in the box from the key board. When defining 9 or more phases (the number of phases is larger than 8), you must enter numbers from the key board. In this case, the colors from Blue to Magenta are repeated in the same order every 6 phases (eg. 8 is Blue, 9 is Cyan, 14 is Blue, ...).
Up to 20 characters are allowable for a phase name. This phase name is printed when the Print-Out function is executed.

5.9.2 Region definition

You can define the shape of the selected area using the Phase Map window (Fig. 28). When displaying a 3-D triangular diagram, select from Rectangle, Up Triangle, or Down Triangle. When displaying a 2-D scatter diagram, select Rectangle only. After designating the shape of the area, place the mouse pointer on a spot in a diagram, which becomes the starting point of the selected area, and drag it to the desired point to select the area. (In selecting a triangular diagram, the first click designates the center of a triangle.) The coordinates are displayed in the Min and Max input boxes in the lower part of the Phase Map window. You can also enter the desired values in the input boxes directly using the keyboard.

You can finely adjust the frame of the selected area using the Rotation buttons (Left, Right, and Reset) and the Shift buttons (Up, Down, Left, and Right). Incidentally, Rotation can be used only when Rectangle is selected.
Every click shifts or rotates the selected frame a little. Continue pressing the mouse button to move the frame farther. The Rotation Reset button cancels the result of rotation and returns to the initial rectangle.

You can select only the desired region from the displayed dot density using the Contour input box (refer to Sect. 5.4). When you do, you can use only the keyboard for entering dot densities.

5.9.3 Phase mapping

This window has the following execution buttons:

Clear phase map (upper right):
: Decides whether to erase the current phase map (“CC” file). Erasing is performed when the Plot button is clicked.
If this button is not clicked on each time the Plot button is clicked, the new phase map will be overlaid on the old phase map.

Plot:
: The phase definition is set in the indicated conditions, then the phase map is actually created according to the definitions.

Stop:
: Phase map creation is stopped. Clicking on the Plot button starts creating the same phase map again.

Clear:
: Cancels the currently displayed phase definition including the Phase name.

Close:
: Closes this window.

Show map:
: If you have selected CC in the current phase map, the phase map is automatically updated and displayed after completion of phase map analysis.

5.10 Save/Load

Click on the arrow head at the right of Save/Load in the Operation menu to display the three sub-menu items (Load, Save, Delete) shown in Fig. 4.

5.10.1 Load

Click on Load to display the list of files. Highlight the file name to be displayed, then click on the Load button on the list window. The image stored in the file is displayed. To erase the displayed image, position the marker at any point on the image and click the mouse button.

5.10.2 Save

Click on Save to display the window for image saving.
Enter a name in the File Name box, then click on the Save button in the window.
After a while, the arrow marker will change to a cross (+).
Place the cross on the window to be saved, and click the mouse button. The contents of the window are saved with the entered file name under the current Group name/Sample name, with the extension of .xwd appended.
To save the contents of all displayed windows, click the gray part of the screen (root window) where there is no window.
Required memory size for saving data depends on the image size, but it may be about 1.3 MB for saving all displayed windows.

✍ The information saved using this function is just the window pattern, and does not include the data behind the window pattern. Therefore, when the saved window is loaded and displayed again, no further processing on the window is possible.

5.10.3 Delete

Click on Delete to display the list of files. Highlight the file name to be deleted, then click on the Delete button on the list window. The image stored in the file is deleted.

6 EXAMPLES OF DISPLAYS

Various kinds of data can be displayed in various types of displays. Figs. 29 to 47 are some examples.

Fig. 29: A scatter diagram (two-dimension plot), showing the relations between two elements in a quantitative analysis.

Fig. 30: A scatter diagram calculated from a quantitative analysis result (refer to Sect. 5.3.5). The least squares fitting method has been applied. The least squares equation is also shown (refer to Sect. 5.3.3).

Fig. 31: A triangle scatter diagram calculated from a quantitative analysis result (refer to Sect. 5.3.5).

Fig. 32: This diagram shows the concentration change along with a line. The line has been drawn connecting the measurement points. The X-axis represents the distance between the 1st measurement point and the other points.

Fig. 33: The coordinates of the measurement points on the stage (specimen) are displayed two-dimensionally. The point of origin of the diagram is the upper right corner.

Fig. 34: One spectrum of the qualitative analysis is displayed. This can be thought of as a scatter diagram of the wavelength of the X-rays and X-ray intensity.

Fig. 35: More than one qualitative analysis spectra are displayed on the same diagram. Comparison between spectra can easily be done.

Fig. 36: A 3-D display of Fig. 35.

Fig. 37: A histogram (one-dimension plot) of the concentration for a specified element in map analysis.

Fig. 38: The same histogram as Fig. 37, but another element's concentration data has been added to the color-coded histogram.

Fig. 39: A scatter diagram of two elements from map analysis data.

Fig. 40: The same scatter diagram as Fig. 39, but the display has been graded by dot density (contour map).

Fig. 41: A triangular diagram of three elements from map analysis data (map data).

Fig. 42: The same scatter diagram as Fig. 41, but the display has been classified by another specified element's concentration. The correlations between four elements can be examined.

Fig. 43: This scatter diagram calculated from map data (refer to Sect. 5.3.5).

Fig. 44: This diagram shows a phase definition being executed on a scatter diagram.

Fig. 45: A phase map created from the original map data.

Fig. 46: This figure shows the result of extracting a portion of a map by using the Conditional element function and saving the data by the Save Result function. The upper right is a Mn map image and the upper left is a Mg map image. On the other hand, the lower right image is the same Mn map as the upper right image, but is conditioned by limiting the intensity range for plotting. The lower left image shows the same Mg map image as the upper left but is extracted by the conditioned Mn map image (lower right).

Fig. 47: In this scatter diagram. the X- and Y-coordinates of the stage are taken as the X- and Y- variables of the scatter diagram. A map can be displayed on the scatter diagram.

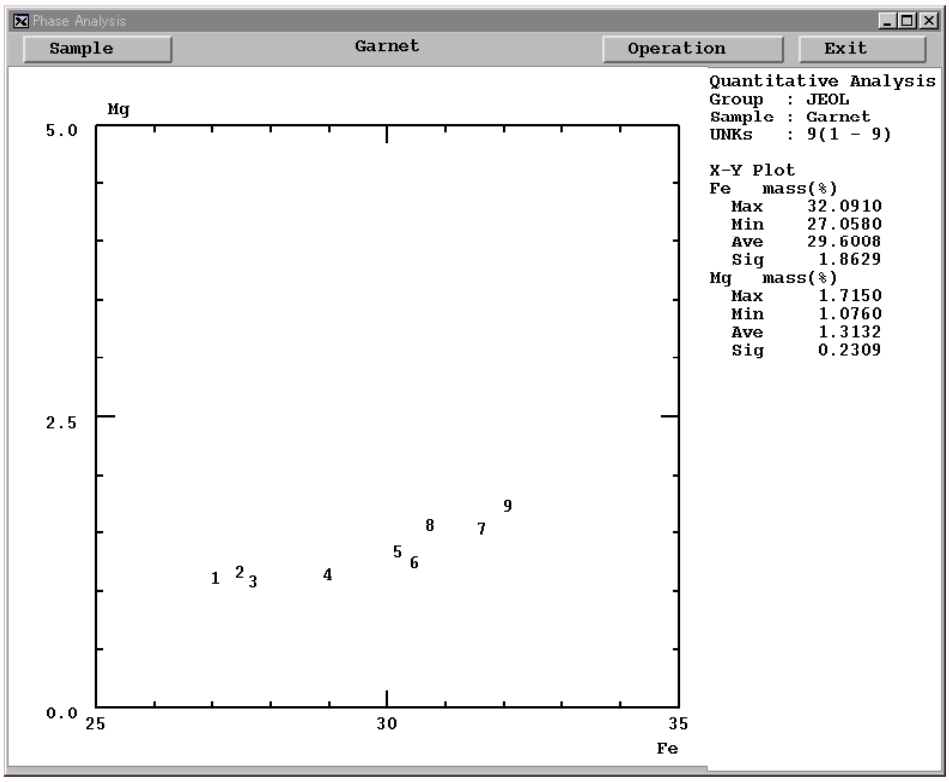

Phase Analysis
Sample
Garnet
Operation
Exit
Mg
5.0
2.5
0.0
25
30
35
Fe
1
2
3
4
5
6
7
8
9
Quantitative Analysis
Group : JEOL
Sample : Garnet
UNKs : 9(1 - 9)
X-Y Plot
Fe mass(%)
Max 32.0910
Min 27.0580
Ave 29.6008
Sig 1.8629
Mg mass(%)
Max 1.7150
Min 1.0760
Ave 1.3132
Sig 0.2309

Fig. 29

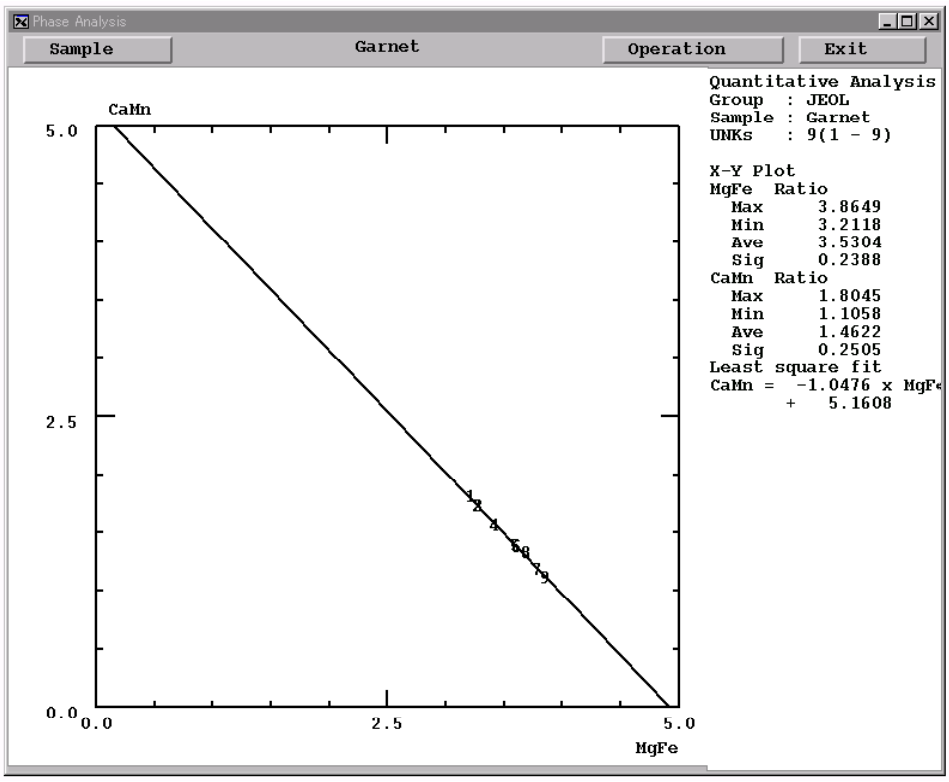

Phase Analysis
Sample
Garnet
Operation
Exit
CaMn
5.0
2.5
0.0
0.0
2.5
5.0
MgFe
Quantitative Analysis
Group : JEOL
Sample : Garnet
UNKs : 9(1 - 9)
X-Y Plot
MgFe Ratio
Max 3.8649
Min 3.2118
Ave 3.5304
Sig 0.2388
CaMn Ratio
Max 1.8045
Min 1.1058
Ave 1.4622
Sig 0.2505
Least square fit
CaMn = -1.0476 x MgFe
+ 5.1608

Fig. 30

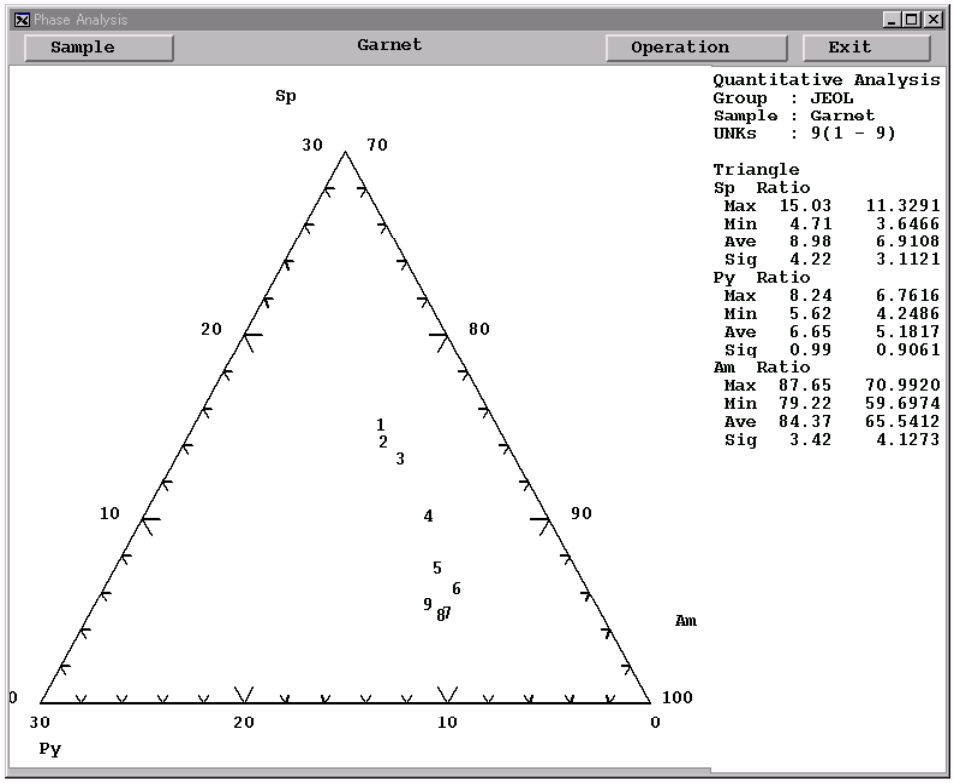

Phase Analysis
Sample
Garnet
Operation
Exit
Sp
30
70
20
80
10
90
0
100
Am
30
20
10
0
Py
1
2
3
4
5
6
9
8
7
Quantitative Analysis
Group : JEOL
Sample : Garnet
UNKs : 9(1 - 9)
Triangle
Sp Ratio
Max 15.03 11.3291
Min 4.71 3.6466
Ave 8.98 6.9108
Sig 4.22 3.1121
Py Ratio
Max 8.24 6.7616
Min 5.62 4.2486
Ave 6.65 5.1817
Sig 0.99 0.9061
Am Ratio
Max 87.65 70.9920
Min 79.22 59.6974
Ave 84.37 65.5412
Sig 3.42 4.1273

Fig. 31

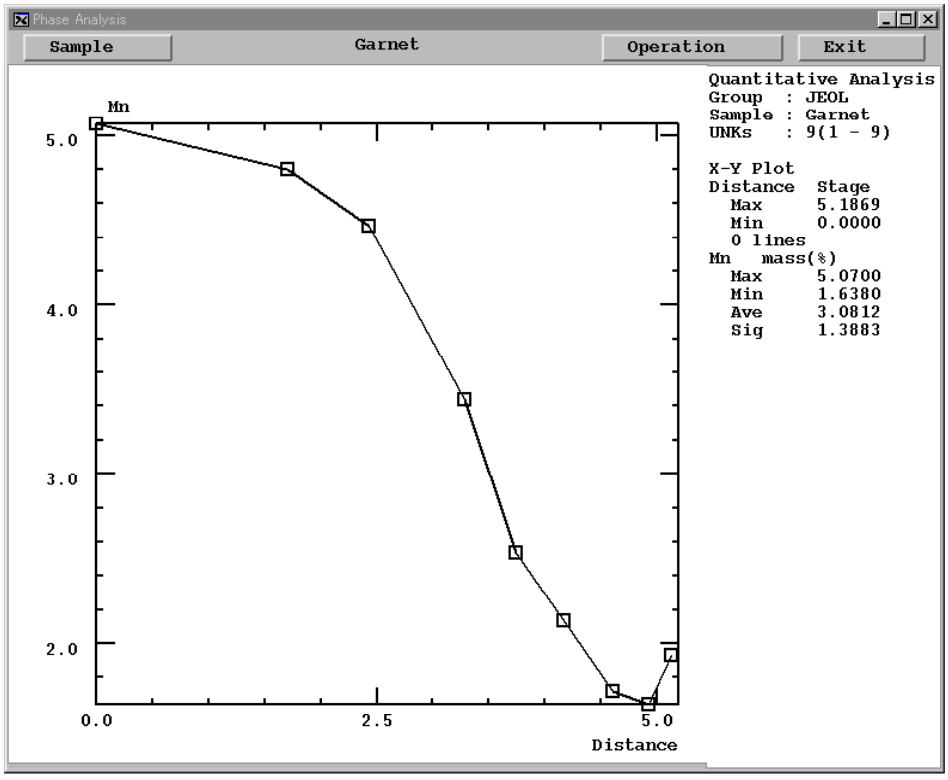

Phase Analysis
Sample
Garnet
Operation
Exit
Mn
5.0
4.0
3.0
2.0
0.0
2.5
5.0
Distance
Quantitative Analysis
Group : JEOL
Sample : Garnet
UNKs : 9(1 - 9)
X-Y Plot
Distance Stage
Max 5.1869
Min 0.0000
0 lines
Mn mass(%)
Max 5.0700
Min 1.6380
Ave 3.0812
Sig 1.3883

Fig. 32

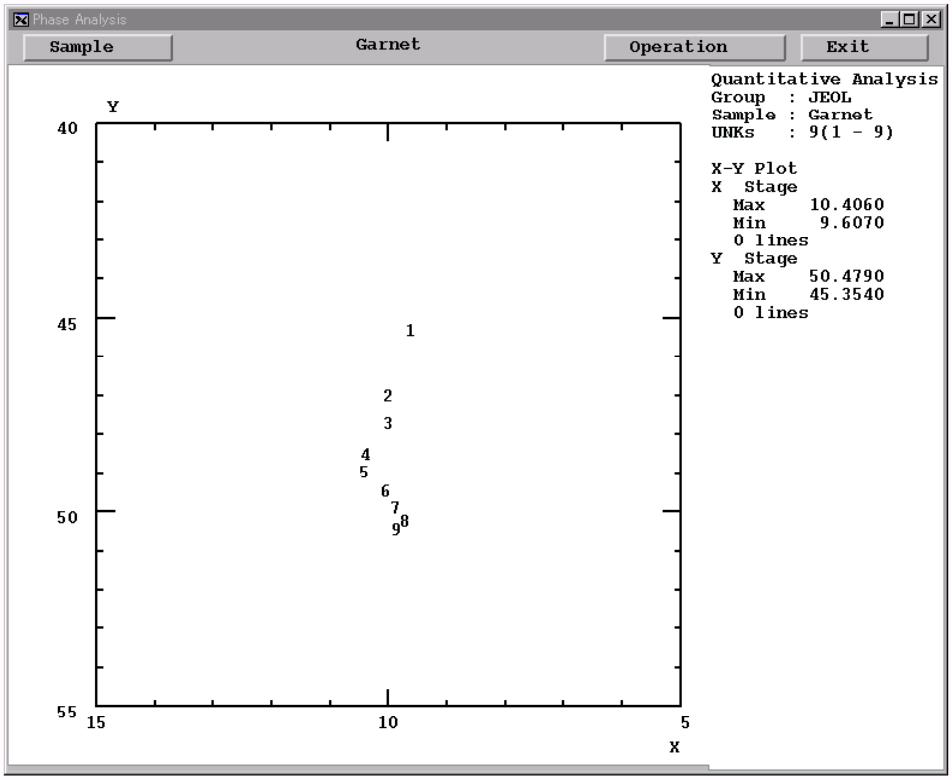

Phase Analysis
Sample
Garnet
Operation
Exit
Quantitative Analysis
Group : JEOL
Sample : Garnet
UNKs : 9(1 - 9)
X-Y Plot
X Stage
Max 10.4060
Min 9.6070
0 lines
Y Stage
Max 50.4790
Min 45.3540
0 lines
Y
40
45
50
55
15
10
5
X
1
2
3
4
5
6
7
8
9

Fig. 33

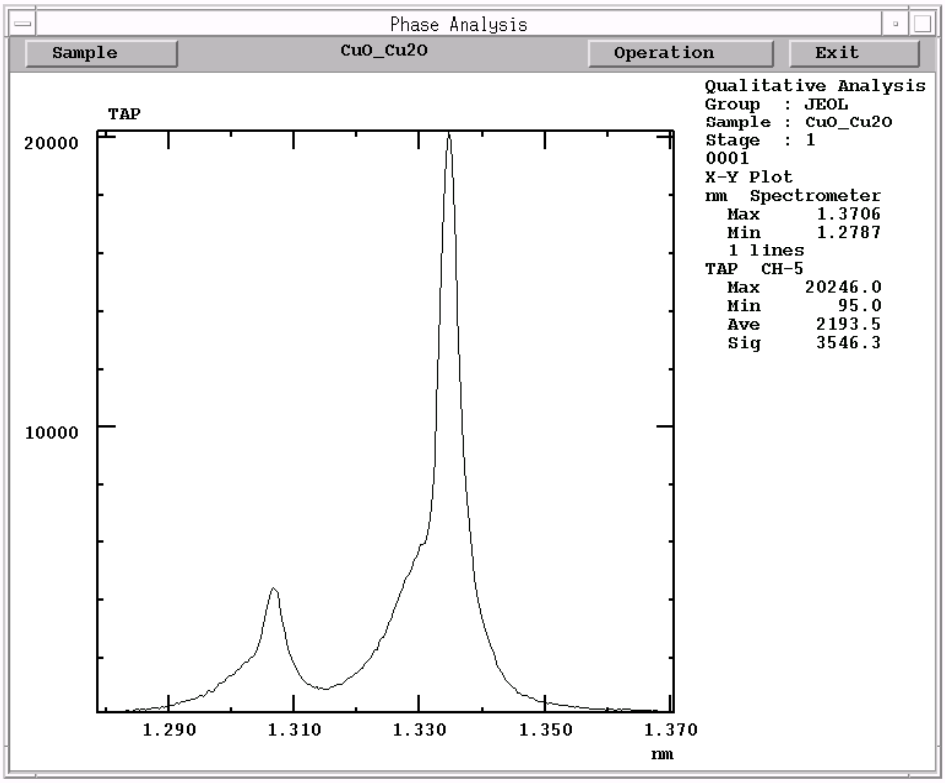

Phase Analysis
Sample
CuO_Cu2O
Operation
Exit
Qualitative Analysis
Group : JEOL
Sample : CuO_Cu2O
Stage : 1
0001
X-Y Plot
nm Spectrometer
Max 1.3706
Min 1.2787
1 lines
TAP CH-5
Max 20246.0
Min 95.0
Ave 2193.5
Sig 3546.3
TAP
20000
10000
1.290
1.310
1.330
1.350
1.370
nm

Fig. 34

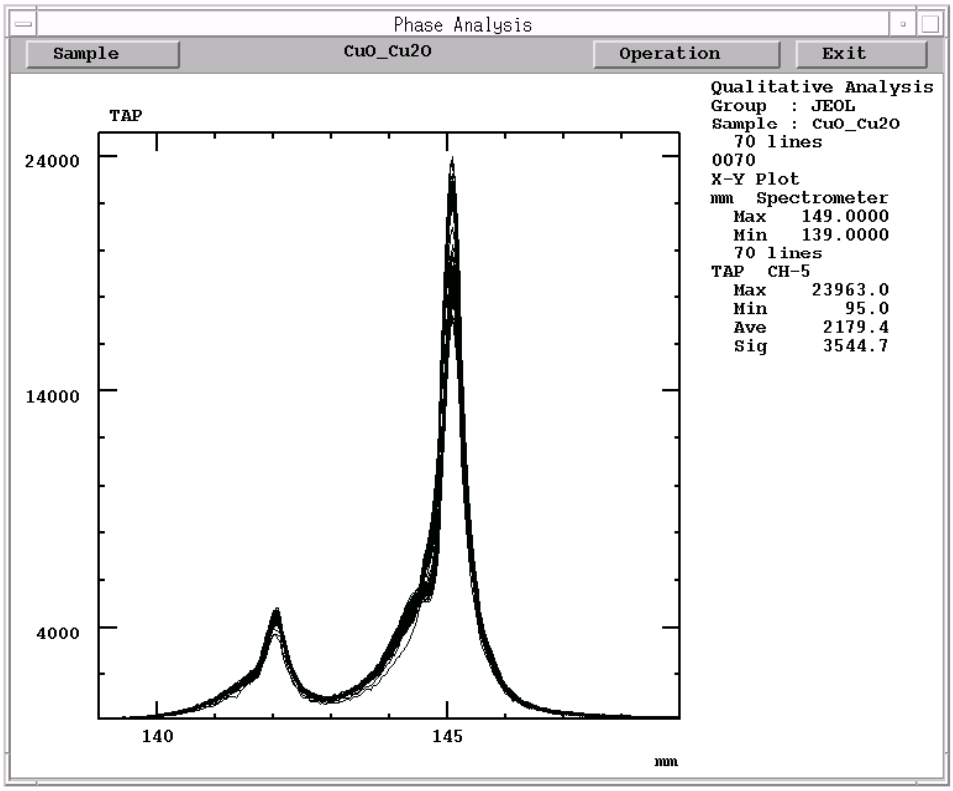

Phase Analysis
Sample
CuO_Cu2O
Operation
Exit
TAP
24000
14000
4000
140
145
mm
Qualitative Analysis
Group : JEOL
Sample : CuO_Cu2O
70 lines
0070
X-Y Plot
mm Spectrometer
Max 149.0000
Min 139.0000
70 lines
TAP CH-5
Max 23963.0
Min 95.0
Ave 2179.4
Sig 3544.7

Fig. 35

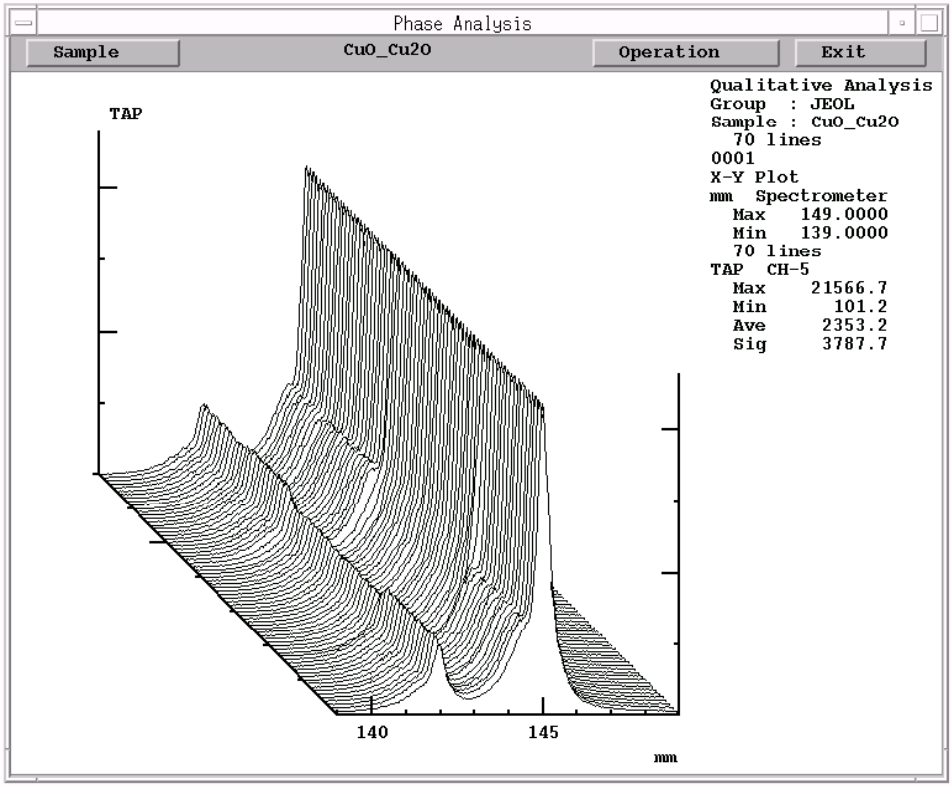

Phase Analysis
Sample
CuO_Cu2O
Operation
Exit
TAP
140
145
mm
Qualitative Analysis
Group : JEOL
Sample : CuO_Cu2O
70 lines
0001
X-Y Plot
mm Spectrometer
Max 149.0000
Min 139.0000
70 lines
TAP CH-5
Max 21566.7
Min 101.2
Ave 2353.2
Sig 3787.7

Fig. 36

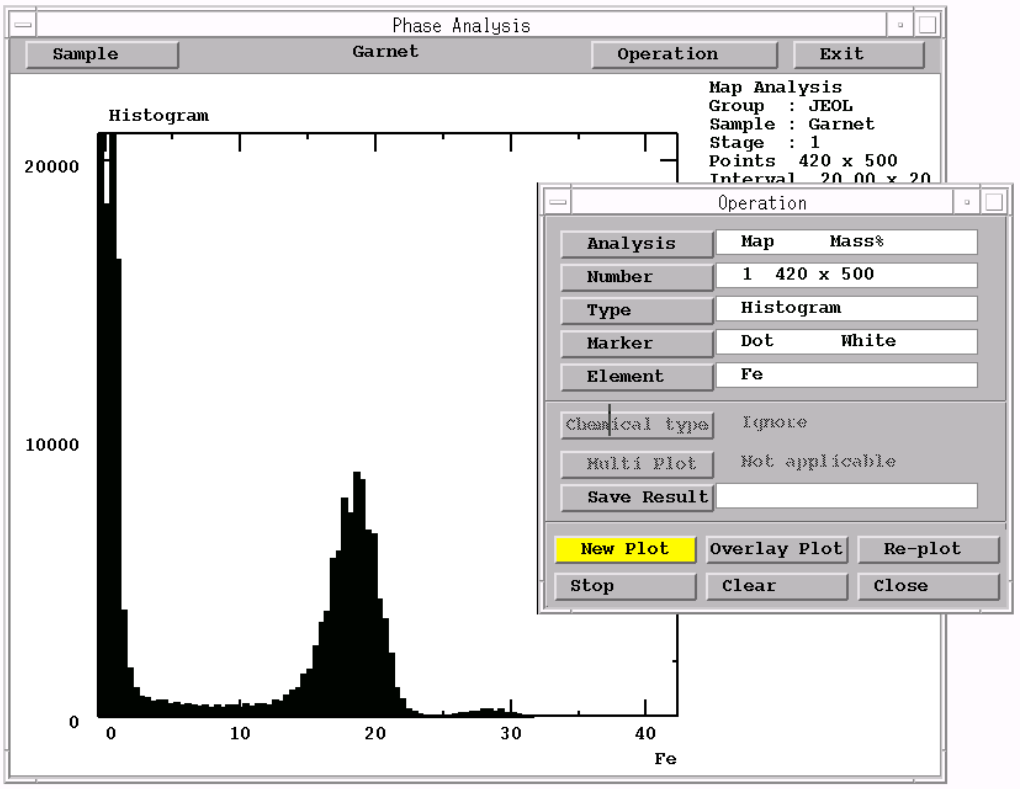

Phase Analysis
Sample
Garnet
Operation
Exit
Map Analysis
Group : JEOL
Sample : Garnet
Stage : 1
Points 420 x 500
Histogram
20000
10000
0
0
10
20
30
40
Fe
Operation
Analysis
Map Mass%
Number
1 420 x 500
Type
Histogram
Marker
Dot White
Element
Fe
Chemical type
Ignore
Multi Plot
Not applicable
Save Result
New Plot
Overlay Plot
Re-plot
Stop
Clear
Close

Fig. 37

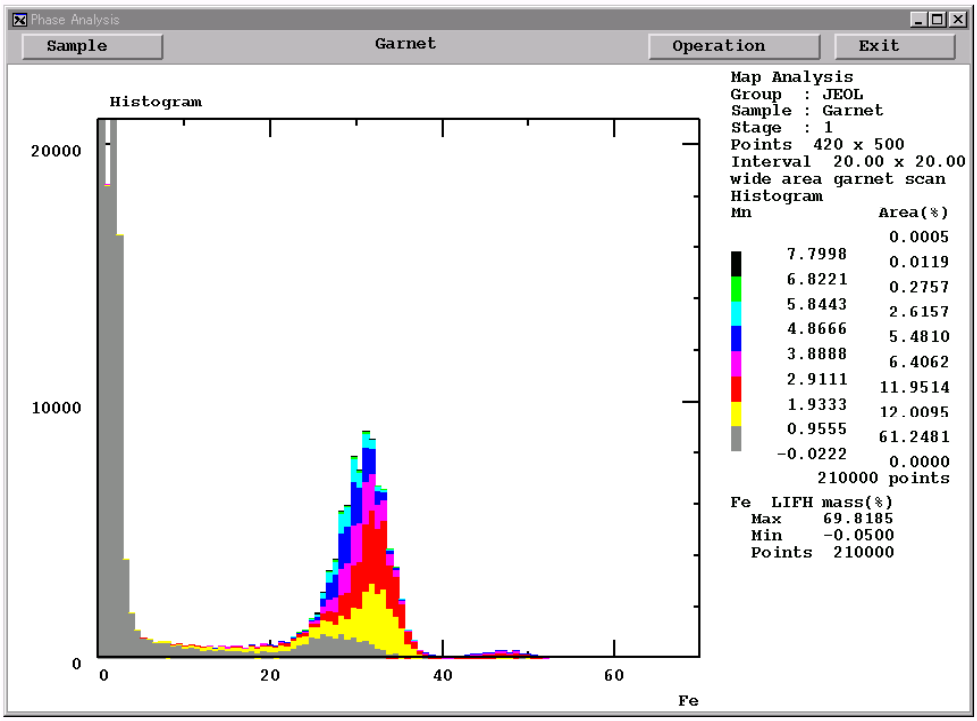

Phase Analysis
Sample
Garnet
Operation
Exit
Map Analysis
Group : JEOL
Sample : Garnet
Stage : 1
Points 420 x 500
Interval 20.00 x 20.00
wide area garnet scan
Histogram
Mn
Area(%)
7.7998 0.0005
6.8221 0.0119
5.8443 0.2757
4.8666 2.6157
3.8888 5.4810
2.9111 6.4062
1.9333 11.9514
0.9555 12.0095
-0.0222 61.2481
0.0000
210000 points
Fe LIFH mass(%)
Max 69.8185
Min -0.0500
Points 210000
Histogram
20000
10000
0
0
20
40
60
Fe

Fig. 38

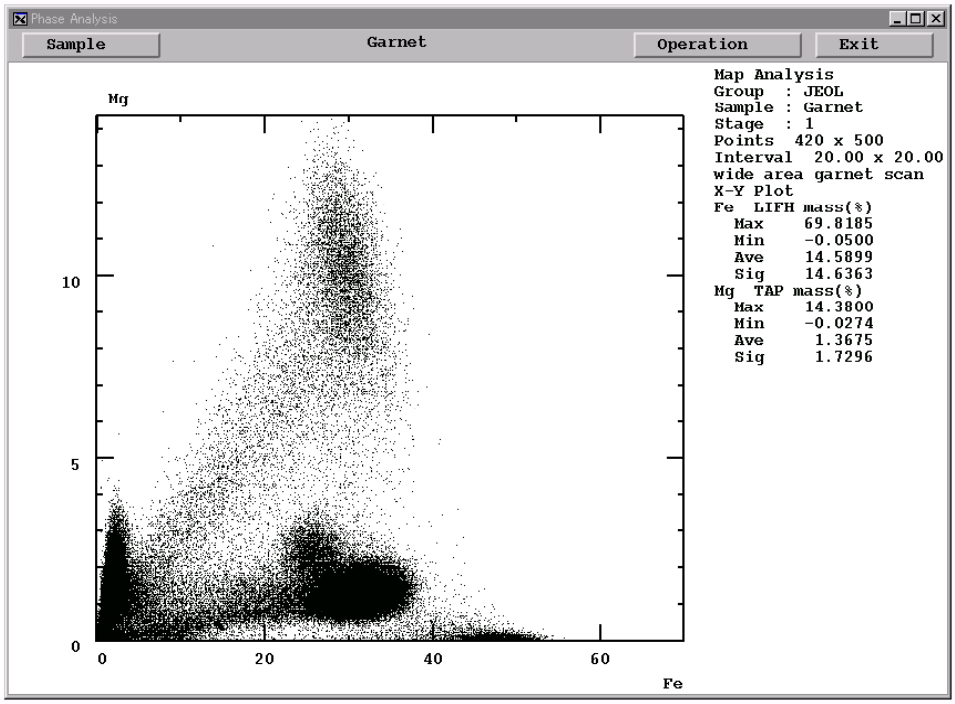

Phase Analysis
Sample
Garnet
Operation
Exit
Mg
10
5
0
0
20
40
60
Fe
Map Analysis
Group : JEOL
Sample : Garnet
Stage : 1
Points 420 x 500
Interval 20.00 x 20.00
wide area garnet scan
X-Y Plot
Fe LIFH mass(%)
Max 69.8185
Min -0.0500
Ave 14.5899
Sig 14.6363
Mg TAP mass(%)
Max 14.3800
Min -0.0274
Ave 1.3675
Sig 1.7296

Fig. 39

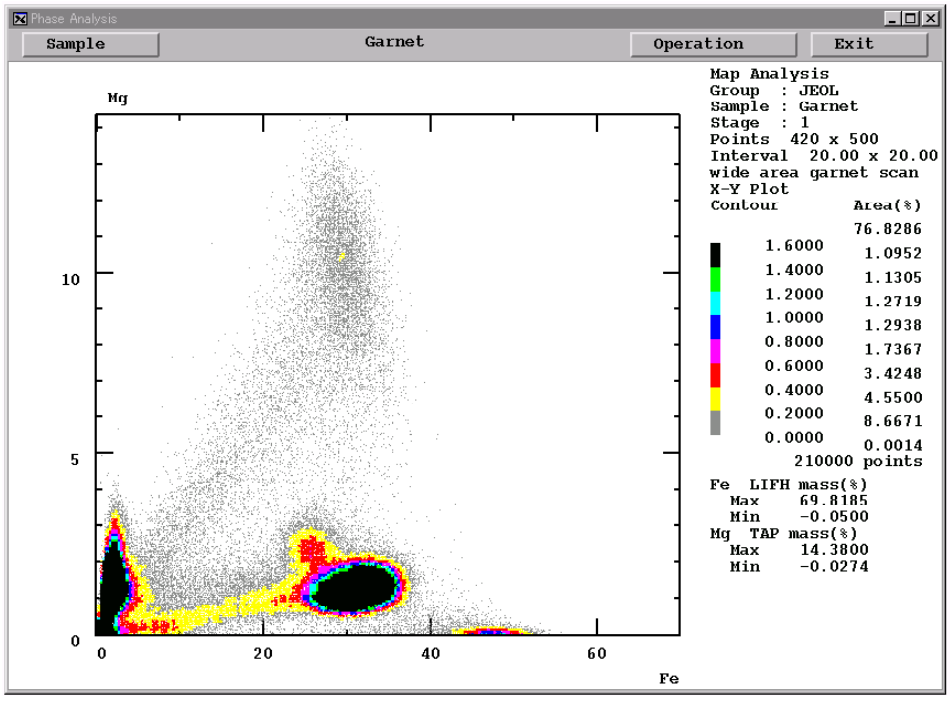

Phase Analysis
Sample
Garnet
Operation
Exit
Mg
10
5
0
0
20
40
60
Fe
Map Analysis
Group : JEOL
Sample : Garnet
Stage : 1
Points 420 x 500
Interval 20.00 x 20.00
wide area garnet scan
X-Y Plot
Contour Area(%)
76.8286
1.6000 1.0952
1.4000 1.1305
1.2000 1.2719
1.0000 1.2938
0.8000 1.7367
0.6000 3.4248
0.4000 4.5500
0.2000 8.6671
0.0000 0.0014
210000 points
Fe LIFH mass(%)
Max 69.8185
Min -0.0500
Mg TAP mass(%)
Max 14.3800
Min -0.0274

Fig. 40

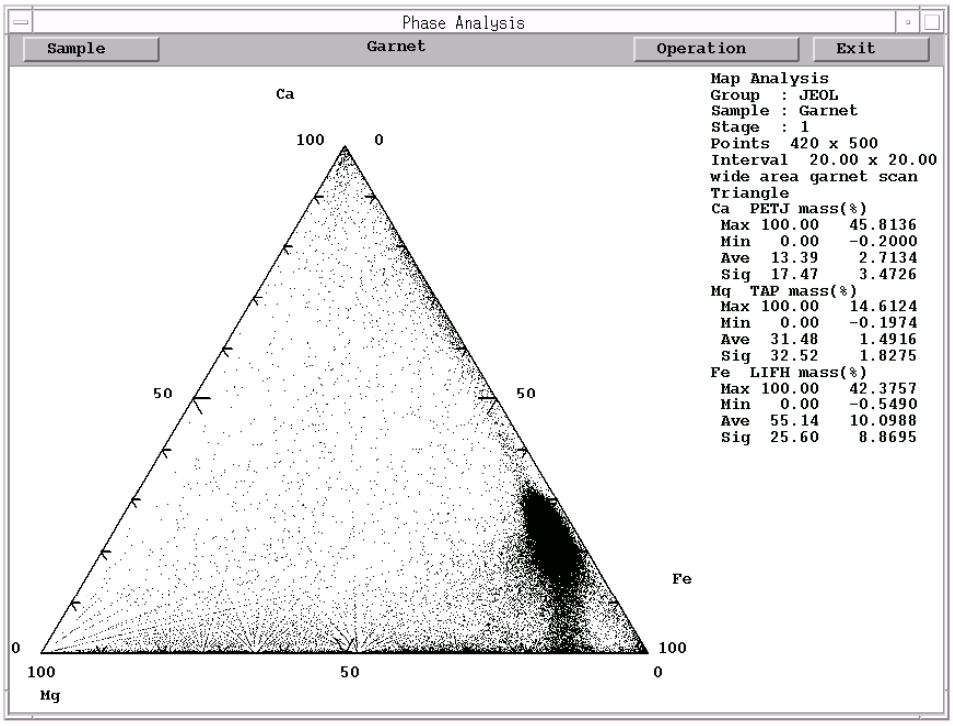

Phase Analysis
Sample
Garnet
Operation
Exit
Ca
100
0
50
50
Fe
0
100
100
50
0
Mg
Map Analysis
Group : JEOL
Sample : Garnet
Stage : 1
Points 420 x 500
Interval 20.00 x 20.00
wide area garnet scan
Triangle
Ca PETJ mass(%)
Max 100.00 45.8136
Min 0.00 -0.2000
Ave 13.39 2.7134
Sig 17.47 3.4726
Mg TAP mass(%)
Max 100.00 14.6124
Min 0.00 -0.1974
Ave 31.48 1.4916
Sig 32.52 1.8275
Fe LIFH mass(%)
Max 100.00 42.3757
Min 0.00 -0.5490
Ave 55.14 10.0988
Sig 25.60 8.8695

Fig. 41

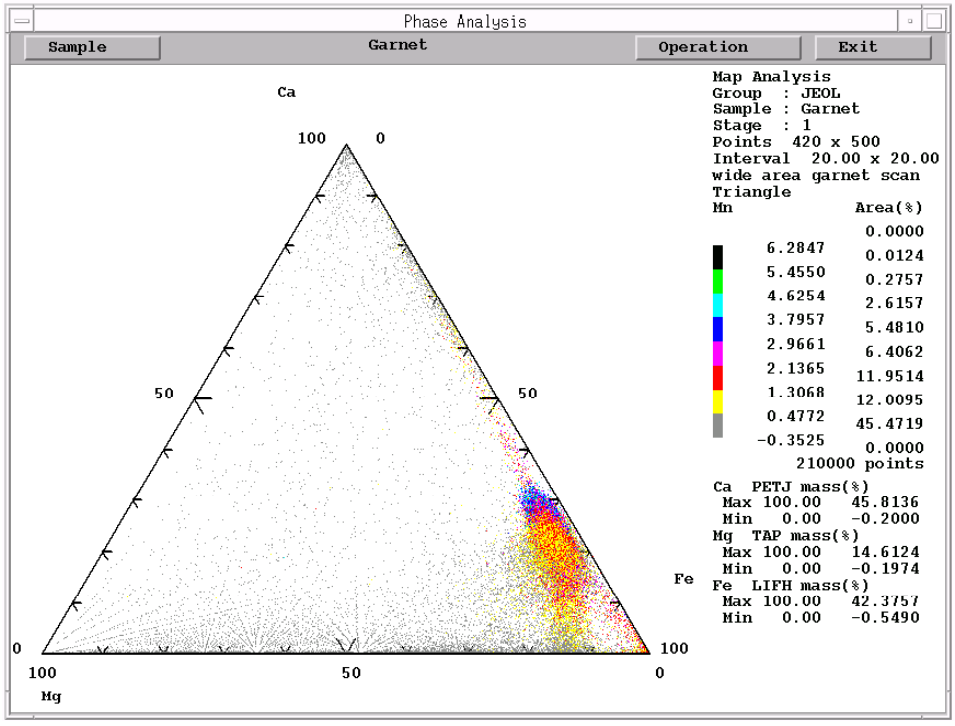

Phase Analysis
Sample
Garnet
Operation
Exit
Ca
100
0
50
50
Fe
0
100
100
50
0
Mg
Map Analysis
Group : JEOL
Sample : Garnet
Stage : 1
Points 420 x 500
Interval 20.00 x 20.00
wide area garnet scan
Triangle
Mn
Area(%)
6.2847 0.0000
5.4550 0.0124
4.6254 0.2757
3.7957 2.6157
2.9661 5.4810
2.1365 6.4062
1.3068 11.9514
0.4772 12.0095
-0.3525 45.4719
0.0000
210000 points
Ca PETJ mass(%)
Max 100.00 45.8136
Min 0.00 -0.2000
Mg TAP mass(%)
Max 100.00 14.6124
Min 0.00 -0.1974
Fe LIFH mass(%)
Max 100.00 42.3757
Min 0.00 -0.5490

Fig. 42

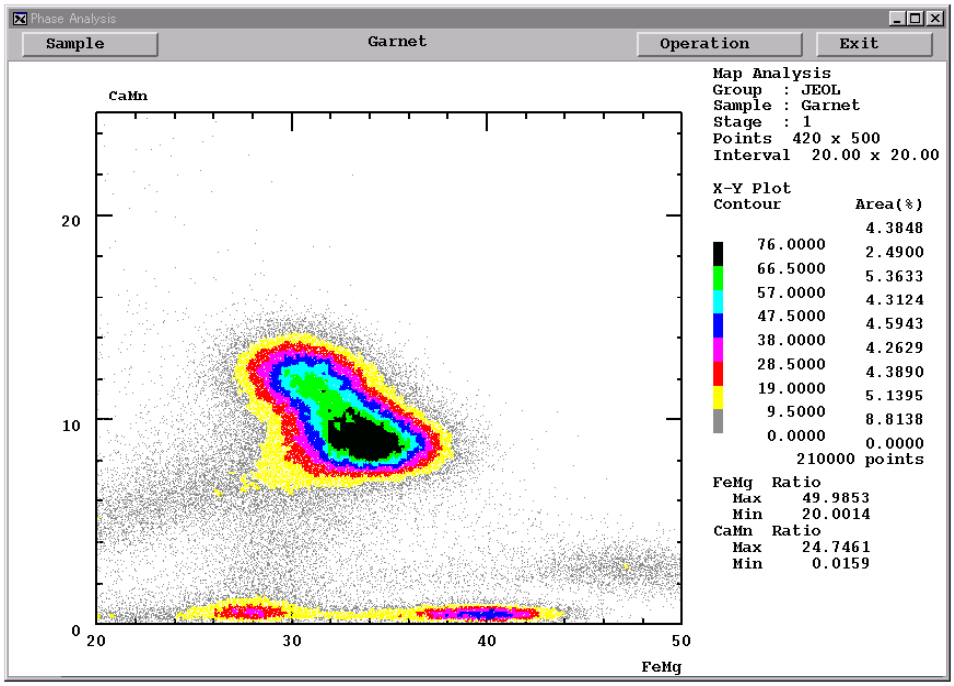

Phase Analysis
Sample
Garnet
Operation
Exit
CaMn
20
10
0
20
30
40
50
FeMg
Map Analysis
Group : JEOL
Sample : Garnet
Stage : 1
Points 420 x 500
Interval 20.00 x 20.00
X-Y Plot
Contour
Area(%)
76.0000 4.3848
66.5000 2.4900
57.0000 5.3633
47.5000 4.3124
38.0000 4.5943
28.5000 4.2629
19.0000 4.3890
9.5000 5.1395
0.0000 8.8138
0.0000
210000 points
FeMg Ratio
Max 49.9853
Min 20.0014
CaMn Ratio
Max 24.7461
Min 0.0159

Fig. 43

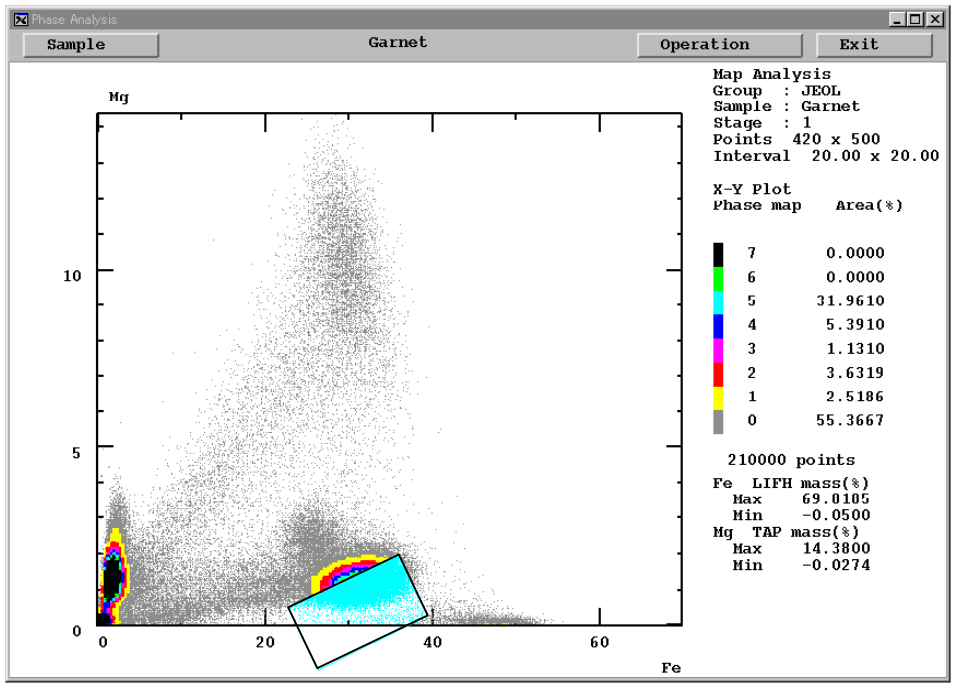

Phase Analysis
Sample
Garnet
Operation
Exit
Mg
10
5
0
0
20
40
60
Fe
Map Analysis
Group : JEOL
Sample : Garnet
Stage : 1
Points 420 x 500
Interval 20.00 x 20.00
X-Y Plot
Phase map
Area(%)
7 0.0000
6 0.0000
5 31.9610
4 5.3910
3 1.1310
2 3.6319
1 2.5186
0 55.3667
210000 points
Fe LIFH mass(%)
Max 69.0105
Min -0.0500
Mg TAP mass(%)
Max 14.3800
Min -0.0274

Fig. 44

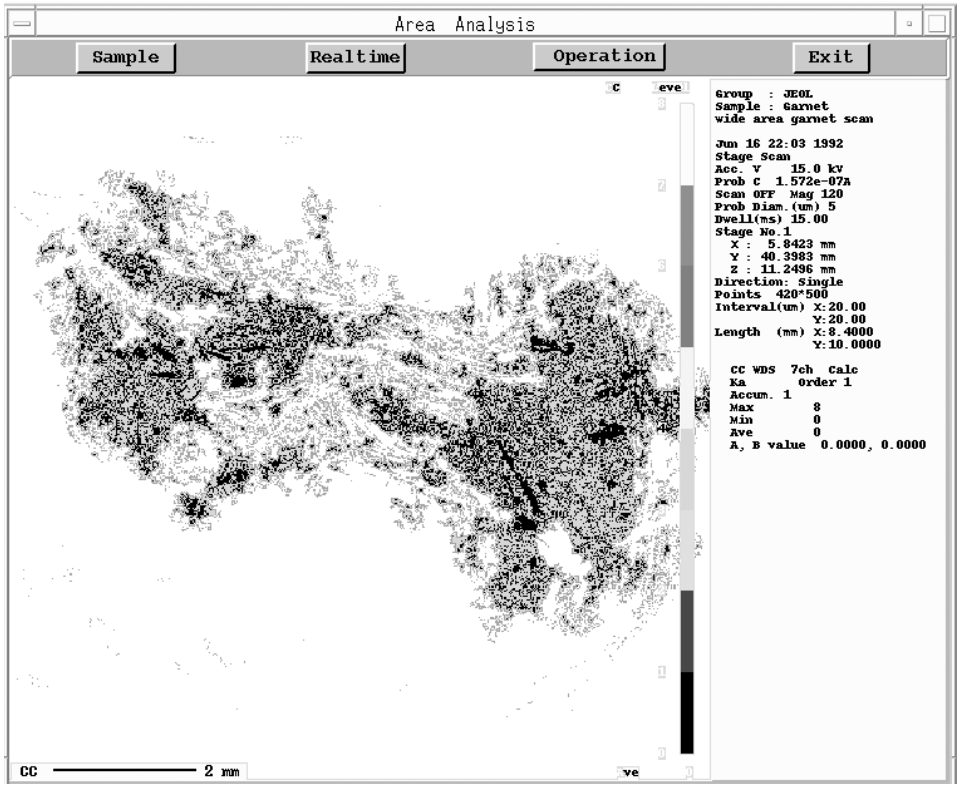

Area Analysis
Sample
Realtime
Operation
Exit
C
eve
Group : JEOL
Sample : Garnet
wide area garnet scan
Jun 16 22:03 1992
Stage Scan
Acc. V 15.0 kV
Prob C 1.572e-07A
Scan OFF Mag 120
Prob Diam.(um) 5
Dwell(ms) 15.00
Stage No.1
X : 5.8423 mm
Y : 40.3983 mm
Z : 11.2496 mm
Direction: Single
Points 420*500
Interval(um) X:20.00
Y:20.00
Length (mm) X:8.4000
Y:10.0000
CC WDS 7ch Calc
Ka Order 1
Accum. 1
Max 8
Min 0
Ave 0
A, B value 0.0000, 0.0000
CC
2 mm
ve

Fig. 45

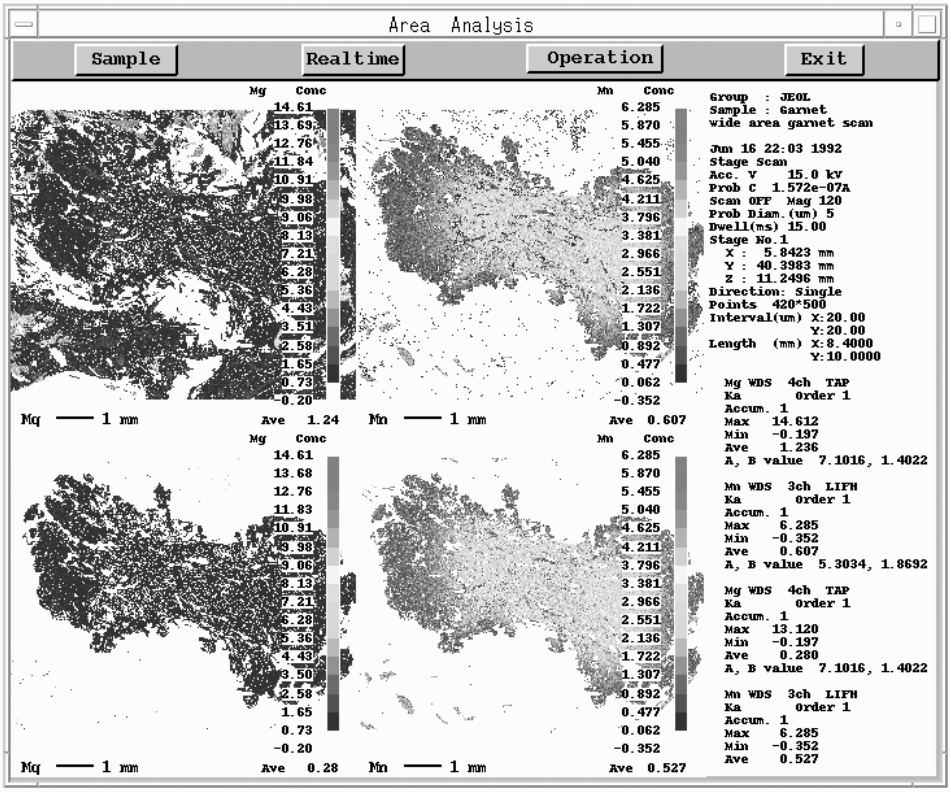

Area Analysis
Sample
Realtime
Operation
Exit
Mg Conc
14.61
13.69
12.76
11.84
10.91
9.98
9.06
8.13
7.21
6.28
5.36
4.43
3.51
2.58
1.65
0.73
-0.20
Mg
1 mm
Ave 1.24
Mn Conc
6.285
5.870
5.455
5.040
4.625
4.211
3.796
3.381
2.966
2.551
2.136
1.722
1.307
0.892
0.477
0.062
-0.352
Mn
1 mm
Ave 0.607
Mg Conc
14.61
13.68
12.76
11.83
10.91
9.98
9.06
8.13
7.21
6.28
5.36
4.43
3.50
2.58
1.65
0.73
-0.20
Mg
1 mm
Ave 0.28
Mn Conc
6.285
5.870
5.455
5.040
4.625
4.211
3.796
3.381
2.966
2.551
2.136
1.722
1.307
0.892
0.477
0.062
-0.352
Mn
1 mm
Ave 0.527
Group : JEOL
Sample : Garnet
wide area garnet scan
Jun 16 22:03 1992
Stage Scan
Acc. V 15.0 kV
Prob C 1.572e-07A
Scan OFF Mag 120
Prob Diam.(um) 5
Dwell(ms) 15.00
Stage No.1
X : 5.8423 mm
Y : 40.3983 mm
Z : 11.2496 mm
Direction: Single
Points 420*500
Interval(um) X:20.00
Y:20.00
Length (mm) X:8.4000
Y:10.0000
Mg WDS 4ch TAP
Ka Order 1
Accum. 1
Max 14.612
Min -0.197
Ave 1.236
A, B value 7.1016, 1.4022
Mn WDS 3ch LIFH
Ka Order 1
Accum. 1
Max 6.285
Min -0.352
Ave 0.607
A, B value 5.3034, 1.8692
Mg WDS 4ch TAP
Ka Order 1
Accum. 1
Max 13.120
Min -0.197
Ave 0.280
A, B value 7.1016, 1.4022
Mn WDS 3ch LIFH
Ka Order 1
Accum. 1
Max 6.285
Min -0.352
Ave 0.527

Fig. 46

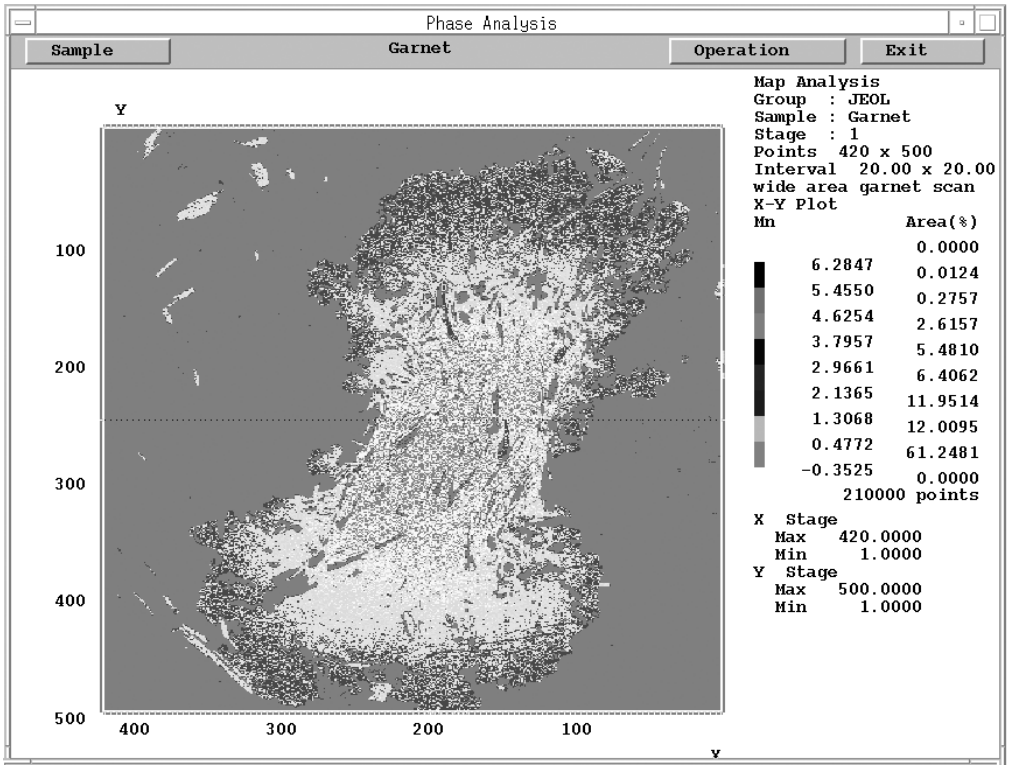

Phase Analysis
Sample
Garnet
Operation
Exit
Y
100
200
300
400
500
400
300
200
100
X
Map Analysis
Group : JEOL
Sample : Garnet
Stage : 1
Points 420 x 500
Interval 20.00 x 20.00
wide area garnet scan
X-Y Plot
Mn
Area(%)
6.2847
5.4550
4.6254
3.7957
2.9661
2.1365
1.3068
0.4772
-0.3525
0.0000
0.0124
0.2757
2.6157
5.4810
6.4062
11.9514
12.0095
61.2481
0.0000
210000 points
X Stage
Max 420.0000
Min 1.0000
Y Stage
Max 500.0000
Min 1.0000

Fig. 47

7 EXAMPLES OF DISPLAYING PLOTS

- **Displaying an element distribution from a quantitative analysis result along a line (line analysis) (Fig. 32)**

  Select X-Y plane and Connect with lines in the “Plotting Type” window (Fig. 9). Then set X- or Y- Distance to the Plot [X] boxes and the element name to the Plot [Y] boxes in the Elements window (Fig. 13).

- **Displaying quantitative analysis points on a stage X-Y plane diagram (Fig. 33)**

  Select [X-Y plane] in the Plotting Type window (Fig. 9). Then set X to the Plot [X] boxes and Y to the Plot [Y] boxes in the Elements window (Fig. 22).
  In this case, if an element was specified in the Element box in the Element window (Fig. 22), the data numbers are displayed in the designated color, and the two-dimensional element distribution can be shown.

- **Plotting a scatter diagram with newly defined formulas (Fig. 30)**

  Define new formulas according to Check Ratio (refer to Sect. 5.3.5).
  To do this, you have to use the text editor. It is recommended that you check the values using the Summary program in the Basic Software before actual application.

- **Displaying spectra from qualitative or line analysis data (Fig. 34)**

  Select [X-Y plane] and [Connect with lines] in the Plotting Type window (Fig. 9). Then set a distance related item to the Plot [X] box and a crystal name or element name to the Plot [Y] box in the Elements window (Fig. 15) (the [X], and [Y] boxes do not related to the X and Y axes, in this case).

- **Overlaying spectra in qualitative or line analyses data (Fig. 35)**

  Select multiple samples in the Select Sample window (Fig. 7).
  Select [X-Y plane] and [Connect with lines] in the Plotting Type window (Fig. 9).
  When normalizing the height of the spectrum, click on the [Normalize] button in the Multi Plot window (Fig. 18).

- **3-D display of qualitative or line analyses data (Fig. 36)**

  Select multiple samples in the Select Sample window (Fig. 7).
  Click on the [Default] button in the Multi Plot window to plot the spectra (Fig. 18).
  If the plotted pattern is not suitable, change the [X offset] and/or [Y offset] value(s), and plot the spectra again.

- **Adjusting the differences in dot density for better display (Fig. 40)**

  After plotting a scatter diagram, display data using the Contour window (Fig. 22). A thinly dotted area is displayed dark and a densely dotted area is displayed bright.

- **Plotting a map on a scatter diagram (Fig. 47)**

  Select [X-Y plane] in the Plotting Type window (Fig. 9). Then set X to the Plot [X] boxes and Y to the Plot [Y] boxes in the Elements window (Fig. 15).
  Specify one element in the [Element] box in the Element window (Fig. 22) and plot the data.

- **Displaying the result of a phase analysis in another program**

  Select the CC element in the map analysis display program.

- **Extracting a portion of map data according to the designated phase (Fig. 46)**

  Use the Save-Result menu and designate the number to newly save data when executing the Phase map (refer to Fig. 19).
  After execution, a portion of the phase is extracted from the other map data.

- **Overlaying a phase map whose phase is defined by different element combinations than that of the previous phase map**

  Phase map data is overlaid on the CC file every time the [Plot] button is clicked unless the [Clear phase map] button on the Phase Map window (Fig. 28) is clicked on. Therefore, you can optionally change the combination of phase elements during phase mapping.

- **Displaying a window in the full screen size**

  Click on the Maximize button, at the top right corner of the window to display the window in full screen size. In order to display the plotted diagram again, click on the [Re-plot] button (displayed in yellow) in the Operation window. The new plotting takes much longer than it does in the original size.