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IMPRI USERS' GUIDE

(Preliminary Edition)

Industrial Minerals Prices Database

Reference Manual

by

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Acknowledgements

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PREFACE

The IMPRI database was designed to provide prices' information on a wide range of industrial minerals and commodities. Because very few, if any, of such commodities are traded in centralised markets like the LME, and prices information is less readily available, the database also incorporates trade information. Trade sources of data can provide price indications based on average annual unit values of imports and exports. Presently IMPRI contains data for about 35 commodities. However, the Branch intends to also introduce monthly market prices data in 1986. At that time this preliminary version of the Users' Guide, prepared to assist those already using IMPRI, will be revised.

IMPRI was instigated by Aert Driessen, Principal Commodity Specialist (Industrial Minerals) Mineral Commodities Branch and Rae Lorenz, Database Administrator, Mineral Information and Statistics Section. The data were collected, entered and verified by Kim Beven. The physical structure of the database and user functions were implemented by Dr Ahnont Wongseelaschote, Branch Manager, I.P. Sharp Associates Limited. The Users' Guide was prepared for publication by Sonja Lenz.

J. Ward
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Mineral Commodities Branch

13 May 1986

1. **PRICES:** their use in the mineral industry.

Price variations in a free-market economy reflect the net outcome of interacting market forces applied by producers and consumers as agents of supply and demand. In mixed economies, such as those of most western-world countries, price changes (or lack of them) can also reflect government intervention in the market place, as was the case in the 1970s when the Australian government temporarily applied minimum prices to zircon and salt. Price changes can also reflect the actions of producers' cartels and monopolies, exchange rate fluctuations, and inflation. Whatever the cause of the fluctuations, prices information, particularly over long periods, can provide useful insights and valuable information to assist making decisions on new capital investment, production and stock level strategies, exploration, and substitution options, etc.

In the long term the price trend for mineral commodities, in real or constant dollar terms, is generally unchanged or downwards and this reflects the ingenuity of producers in finding ways (via new technology and economies of scale) to be more productive and competitive, and the ingenuity of commodity buyers in seeking out cheaper sources of supply. However, in the very long term the real price of some commodities can also rise to reflect scarcity, particularly if substitution is difficult. Long term historical price series can be useful in providing a base from which to project future trends; such forecasts are important for determining mineral exploration strategies and carrying out feasibility studies. By combining price time series with other available time series, such as exchange rates and price indexes, such series can be converted to real or constant dollar terms for any specified currency.

Industrial minerals lack a precise definition, but most of them are non-metallic, non-fuel minerals which are used for their physical, chemical, or metallurgical properties. IMPRI contains prices data for many industrial minerals as well as some of their derived products. An industrial mineral may be sold as a variety of products with different specifications; while mineralogically identical and produced from the same orebody, they might have different colour, particle size, bulk density, and other physical property specifications. Products derived from different deposits usually differ mineralogically and/or chemically. Industrial minerals are not traded in centralised markets such as the London Metal Exchange partly because there is no practical way that specifications for individual commodities can be codified.

All this is not to say that there are no universally-recognised specifications for particular industrial minerals. On the contrary, some industrial mineral commodities, particularly those which tend to be traded internationally and/or have well-established markets, do have generally accepted or codified specifications. Examples are fluorspar which has generally recognised specifications for three grades - metallurgical grade (metspar), ceramic grade, and acid grade; phosphate rock which is marketed in specified grades expressed in BPL (bone phosphate of lime); muriate of potash (potassium chloride), specifications for which include a minimum 60% K_2O equivalent content; and drilling grade barites, specifications for which include a minimum SG (specific gravity) of 4.2. Generally speaking, however, industrial minerals have such wide-ranging end-uses, each requiring different specifications, that it would not be practical to codify them.

Without centralised markets, industrial minerals' prices are generally negotiated privately between producers and consumers and details are not published. Large producers and/or producer groups of internationally-traded commodities (particularly fertiliser raw materials - phosphate rock, potash, and sulphur) often set prices but these serve mainly as a starting point for contract negotiations or for occasional spot sales (spot sales are generally not a feature of industrial mineral markets because continuity of supply of product to set specifications is very important to consumers). In highly competitive markets such prices are often discounted. Sometimes, but particularly for manufactured fertiliser products such as superphosphate, ammonium phosphate, and urea, the setting of prices is sometimes initiated by large consumers/consumer groups by calling for tenders to supply specified quantities of these commodities.

Unlike the metals, for which daily prices are widely published, industrial mineral prices are generally published in specialist journals, seldom more frequently than monthly. Publishers often obtain prices information privately. Many prices are quoted on a c.i.f. northwest Europe basis which limits their interest to those outside that region. To overcome this, BMR is drawing on Australian and United States government-sourced trade data to derive an implicit price series for many commodities, based on the unit value of commodities imported or exported. Unit values are simply derived by dividing the total value of imports or exports in any year by the total quantity imported or exported. For example, Australia in 1983 imported a total of 392 581 t of sulphur, valued at $32 930 000 (f.o.b.). Thus the average unit value was $83.90/t. Average unit values derived from Australian exports and imports, as well as US exports, are on an f.o.b. basis but US imports are on a c.i.f., United States, basis.

Average annual unit value trends follow actual price trends but unit value trends tend to lag behind actual prices, and trade data aggregated over a year tend to also moderate the amplitude of price change. On the other hand unit value data is available for a much longer time span than price data although at this stage BMR has chosen to start the unit values series mainly from 1950.

Commodities and data sources are matched on the basis of the quantity and consistency of trade. For example, rutile unit values are derived from Australian export statistics whereas US export data were chosen as sources for sulphur unit values. Bentonite and diatomite unit values are also derived from US export data as that country is an important world supplier of these commodities. A comprehensive list of commodities by data sources used is as follows:-

Australian exports - gypsum, ilmenite, monazite, rutile, salt, talc, zircon
Australian imports - sulphur
United States exports - bentonite, boron, diatomite, felspar, industrial diamond, kaolin, mica, phosphate rock, superphosphate, elemental phosphorus, potassium sulphate, quartz, sodium carbonate (trona), sulphur, talc.
United States imports - asbestos, barite, chromite, ferrochromium, fluorite, ferromanganese, ferrosilicon, ferrovanadium, graphite, gypsum, ilmenite, magnesia, manganese, monazite, peat, rutile, titanium metal, titanium dioxide pigment, salt, silicon, zircon.

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2. **THE DATA:** background information.

2.1 **Recording and reporting of prices data at BMR**

BMR's Mineral Commodities Branch monitors, collects and publishes prices and unit value data of mineral commodities as an integral part of its mineral industry studies. Prices have been recorded by the Branch since 1948 and are published, with comment on changes during the year, in its **Australian Mineral Industry Annual Review.** In 1974 Mineral Commodities Branch published its first **Monthly Bulletin of Metal, Ore and Concentrate Prices.** This single-sheet publication lists prices for the major metals, but also includes prices for the mineral sands: rutile, zircon, ilmenite, and monazite. There is a growing demand from industry, government and the public for information on price trends and projections. Access to automated database systems which can process and reorganise prices data is of considerable assistance in providing an historical background to price movements. These systems help to formalise, centralise, and standardise monitoring, collection and recording procedures; and systematic storage of the data facilitates access and processing of data and provides for more flexible presentation. IMPRI is a computerised database and provides fast access to industrial mineral prices and unit values of export and import data. IMPRI data can be used in conjunction with ABS databases, OECD, IFS (International Financial Statistics), CURRENCY, and other databases from IP Sharp. For example, data may be operated on to provide time series price equivalents in foreign currencies, real prices and so on, which can then be used to produce tables and graphs or stored for future reference or further processing.

2.2 **The data units**

All data are expressed in units presently in use, which means that obsolete units have already been converted. For example, all pre-1966 data relating to the value of Australian trade have been converted from Australian pounds (£) to dollars and pre-1972 quantity data have been converted from long tons to tonnes (1 tonne - 1.01605 long tons). United States quantity data are expressed in tonnes, long tons (2240 pounds), and short tons (2000 pounds) and these units have been retained. Where the unit of quantity used within one time series has changed over time, the unit used prior to the change has been converted to the unit of quantity presently used. US value data are expressed in US dollars.

2.3 **Length of series**

Whenever practicable, the database series extends back to 1950 although data are available from various published sources for earlier years. Some series start later because reliable data are available only from that time; some thinly-traded commodities cannot be identified individually in earlier years because trade data for them are included with data for other commodities under a single statistical "sink" item; for other commodities, data of earlier years were not included in the database because although the classification criteria for some trade items are specific to a given mineral commodity, in practice that item includes forms of that commodity processed to various stages and thus having very different unit values. For example, crude and highly processed (milled) forms of certain commodities were included under a single item and trade data for standard grade and high analysis phosphatic fertilisers were also aggregated.

3. THE DATABASE

The Industrial Mineral Prices Database (IMPRI) is structured using the IP Sharp MAGICSTORE multidimensional file management system. Further details on file design using MAGICSTORE can be found in the MAGICSTORE USERS' GUIDE. An outline of IMPRI content can be found in Appendix A.

IMPRI consists of three attributes:

- dates
- minerals
- facts.

3.1 Date

Prices data for IMPRI are entered annually on receipt of the "US Bureau of Mines Minerals Yearbook" and computer tapes from the Australian Bureau of Statistics. Years can be accessed as follows:

one year: AT 84
more than a year: 80 TO 84

3.2 Minerals

There are 37 mineral commodities specified in this attribute. They are referred to by their CODES (for codes see 3.4 below).

3.3 Facts

The mineral commodity unit value facts can be any of the following:

AX - Australian exports
AM - Australian imports
USX - United States exports
USM - United States imports

For a complete list of unit values available for each mineral commodity enter:
IMPRI 'DIRECTORY'

3.4 On-line information

A brief description of IMPRI may be obtained while using IP Sharp, as shown below:

```
) LOAD 760 MAGIC
  IMPRI 'DESCRIBE'
```

A complete list of codes can be obtained by keying
IMPRI 'DIRECTORY'

	ILMENITE	RUTILE	ZIRCON
	AUSTRALIAN EXPORT (UNIT VALUE) A$/TONNE	AUSTRALIAN EXPORT (UNIT VALUE) A$/TONNE	AUSTRALIAN EXPORT (UNIT VALUE) A$/TONNE
1974	11.85	140.01	83.80
1975	12.71	188.23	194.42
1976	14.23	209.03	158.16
1977	16.17	216.84	110.27
1978	16.20	186.25	75.41
1979	16.74	218.21	69.07
1980	19.00	281.62	69.86
1981	23.62	296.62	83.28
1982	25.85	255.55	105.52
1983	28.48	244.32	117.78
1984	29.12	302.56	124.31

FIGURE 1: AUSTRALIAN EXPORT UNIT VALUES USING TABLE COMMAND

	1982	1983	1984
ILMENITE			
AUSTRALIAN EXPORT (UNIT VALUE) A$/TONN	25.85	28.48	29.12
RUTILE			
AUSTRALIAN EXPORT (UNIT VALUE) A$/TONN	255.55	244.32	302.56
ZIRCON			
AUSTRALIAN EXPORT (UNIT VALUE) A$/TONN	105.52	117.78	124.31

FIGURE 2: AUSTRALIAN EXPORT UNIT VALUES USING DISPLAY COMMAND

4. DATA RETRIEVAL USING MAGIC

When using MAGIC the first step is to set the timeframe required, then set the AUTOLABEL command if labels for the data are required. The next step is to specify the database (IMPRI) and the unit values required. This is done in the format '[code]', see Appendix A for a list of codes. Separate MINERAL codes and FACTS by a slash 'ZIR/AX', and each code by a comma - 'ILM,RUT,ZIR/AX'.

In the following examples we have assumed, for convenience of exposition, that each example is independent and that a user has either typed)LOAD 760 MAGIC at the start of each example, or has entered CLEAR and RESETOPTIONS, where appropriate.

4.1 Tables of unit values

Unit values may be tabled in two ways.

Figure 1 tables ilmenite, rutile and zircon, Australian export unit values with the years as a row title. The MAGIC commands are as follows:

```
YEARLY,DATED 74 TO 84
AUTOLABEL
FOOTNOTE'FIGURE 1: AUSTRALIAN EXPORT UNIT VALUES USING TABLE
COMMAND'
COLWIDTH 12
TABLE IMPRI'ILM,RUT,ZIR/AX'
```

Figure 2 tables all ilmenite, rutile and zircon unit values for 1982 to 1984 with the years heading the columns. This format is often preferred for shorter time frames. The MAGIC commands used for this format are as follows:

```
YEARLY,DATED 82 TO 84
AUTOLABEL
FOOTNOTE'FIGURE 2: AUSTRALIAN EXPORT UNIT VALUES USING DISPLAY
COMMAND'
DISPLAY IMPRI'ILM,RUT,ZIR/AX'
```

4.2 Producing plots of IMPRI unit values

IMPRI data may be readily produced in the form of graphs using SUPERPLOT. Figure 3 is an example of using graphic representation to compare Australian export unit values for ilmenite, monazite, rutile and zircon from 1975 to 1984. This plot was prepared using the Hewlett-Packard 7475A plotter. The complete set of commands for both MAGIC and SUPERPLOT are as follows:

```
YEARLY, DATED 75 TO 84
1 2 3 4 PUT IMPRI 'MON,RUT,ZIR,ILM/AX'
DSUPERPLOT 'TERM,HP7475A; UNITS,CM; SIZE,24 17,OUTSIDE'
DSUPERPLOT 'TYPE,STR;STYLE,SOLID,LDASH,SDASH,DOT'
DSUPERPLOT 'TITLE,1,AUSTRALIAN EXPORT UNIT VALUES'
DSUPERPLOT 'LABEL,1,MONAZITE,2,RUTILE,3,ZIRCON,4,ILMENITE'
DSUPERPLOT 'YLABEL,A$ PER TONNE'
DSUPERPLOT 'FOOTNOTE,FIGURE 3: COMPARISON OF AUSTRALIAN EXPORT UNIT
VALUES'
PLOT ABOVE
```

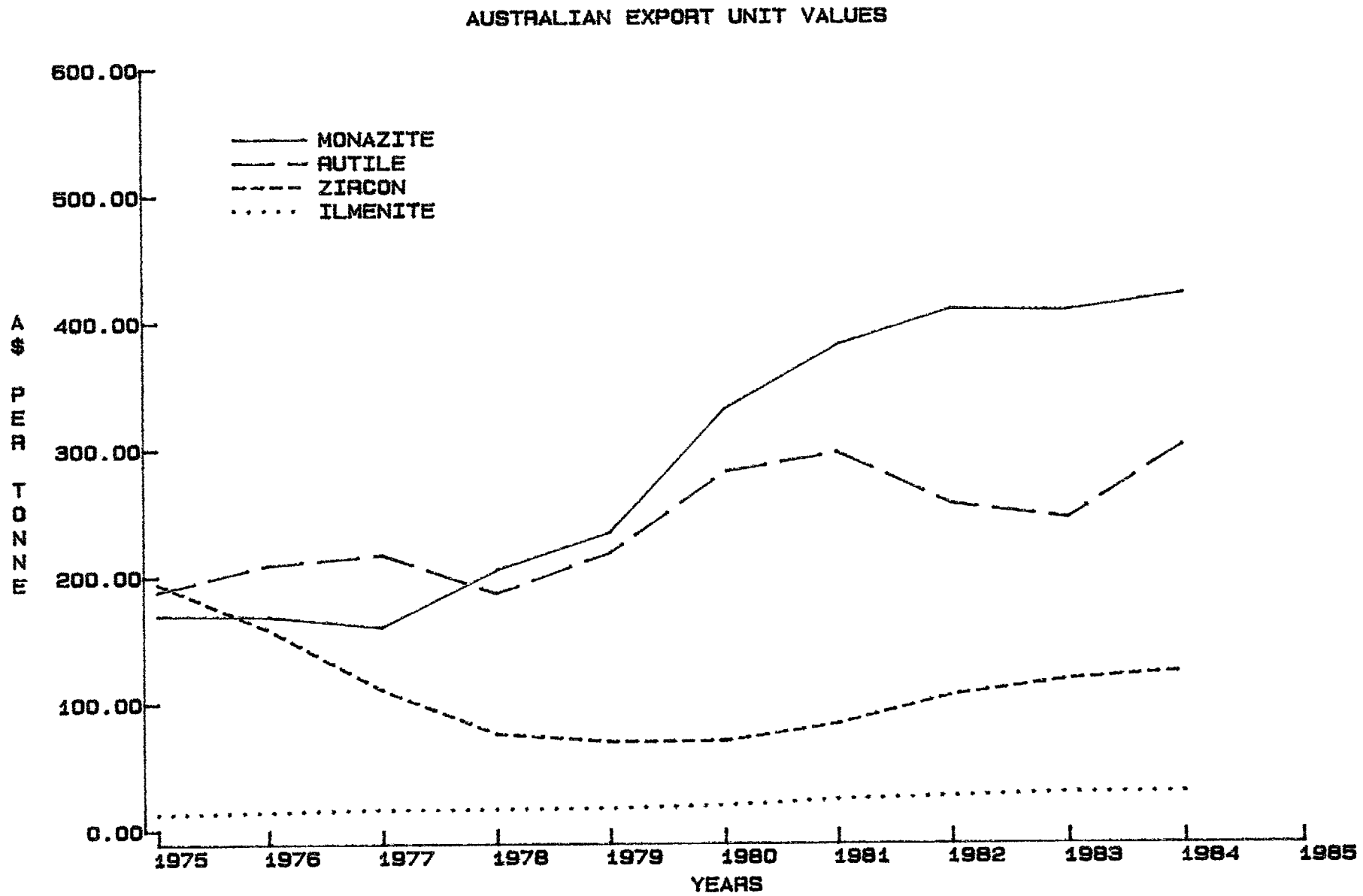

FIGURE 3: COMPARISON OF AUSTRALIAN EXPORT UNIT VALUES

Group plots can also be produced in SUPERPLOT. Figure 4 shows Australian export unit values and US import unit values for gypsum as two plots. The MAGIC, SUPERPLOT commands are:

```
YEARLY, DATED 62
NOAUTOLABEL
1 2 PUT IMPRI'GYP/AX,USM'
DSUPERPLOT 'TERM,HP7475AU; UNITS,CM; SIZE,17 24,OUTSIDE'
DSUPERPLOT 'TYPE,STR; COLOUR,BLACK; STYLE,SOLID'
DSUPERPLOT 'SHADING,1,BOT,45,20,BLACK,SOLID; 2,BOT,135,20,BLACK,SOLID'
DSUPERPLOT 'GROUP,1,1,1,2,2,1'
DSUPERPLOT 'YLABEL,1,A$ PER TONNE,2,US$ PER SHORT TON'
DSUPERPLOT 'TEXTSPEC,TITLE,SIZE,1.5'
DSUPERPLOT 'TITLE,1,GYPSUM,2,(UNIT VALUES)'
DSUPERPLOT 'LABEL,1,AUSTRALIAN EXPORTS,2,US IMPORTS'
DSUPERPLOT 'FOOTNOTE,1,FIGURE 4: EXAMPLE OF GROUP PLOT,
            2,GYPSUM UNIT VALUES - AUSTRALIAN EXPORTS AND US IMPORTS'
PLOT ABOVE
```

4.3 **Real price calculations**

IMPRI data may be acted upon with other IP Sharp data (such as various price indexes or deflators) to produce real or constant dollar price equivalents. Thus IMPRI prices may be adjusted using, for example, an appropriate consumer price index, a gross domestic product deflator, or a wholesale price index; various indexes are available from databases such as the OECD Main Economic Indicators database or the International Financial Statistics database.

Prices and/or unit values expressed in current dollars can be converted to constant (real) dollars by multiplying each current dollar value in the series by the ratio

$$\frac{\text{base year index}}{\text{current year index}}$$

Figure 5 shows the constant dollar (real price, base year 1966) equivalent of Australian export unit values for zircon for the period 1966 to 1984. The deflator used is the consumer price index (CPI) from the Australian Bureau of Statistics database, Australian Economic Statistics.

The plot in Figure 5 is created in MAGIC and SUPERPLOT as follows:

```
YEARLY,DATED 66 TO 84
NOAUTOLABEL
1 PUT IMPRI 'ZIR/AX'
2 PUT AES '516J'
3 PUT (ITEM 1) TIMES DATA [3;1] DIVIDED BY (ITEM 2)
DSUPERPLOT 'TERM,HP7475A; UNITS,CM; SIZE,24 17,OUTSIDE'
DSUPERPLOT 'LINE,1,STR,BLACK,SOLID, ,1;2,STR,BLACK,LDASH, ,1'
DSUPERPLOT 'TITLE,1,ZIRCON UNIT VALUES'
DSUPERPLOT 'LABEL,1,CURRENT DOLLAR VALUES,
            2,CONSTANT (1966) DOLLAR VALUES'
DSUPERPLOT 'YLABEL,A$ PER TONNE'
DSUPERPLOT 'FOOTNOTE,1,FIGURE 5: UNIT VALUES OF AUSTRALIAN EXPORTS OF
           ZIRCON'
PLOT ITEM 1 3
```

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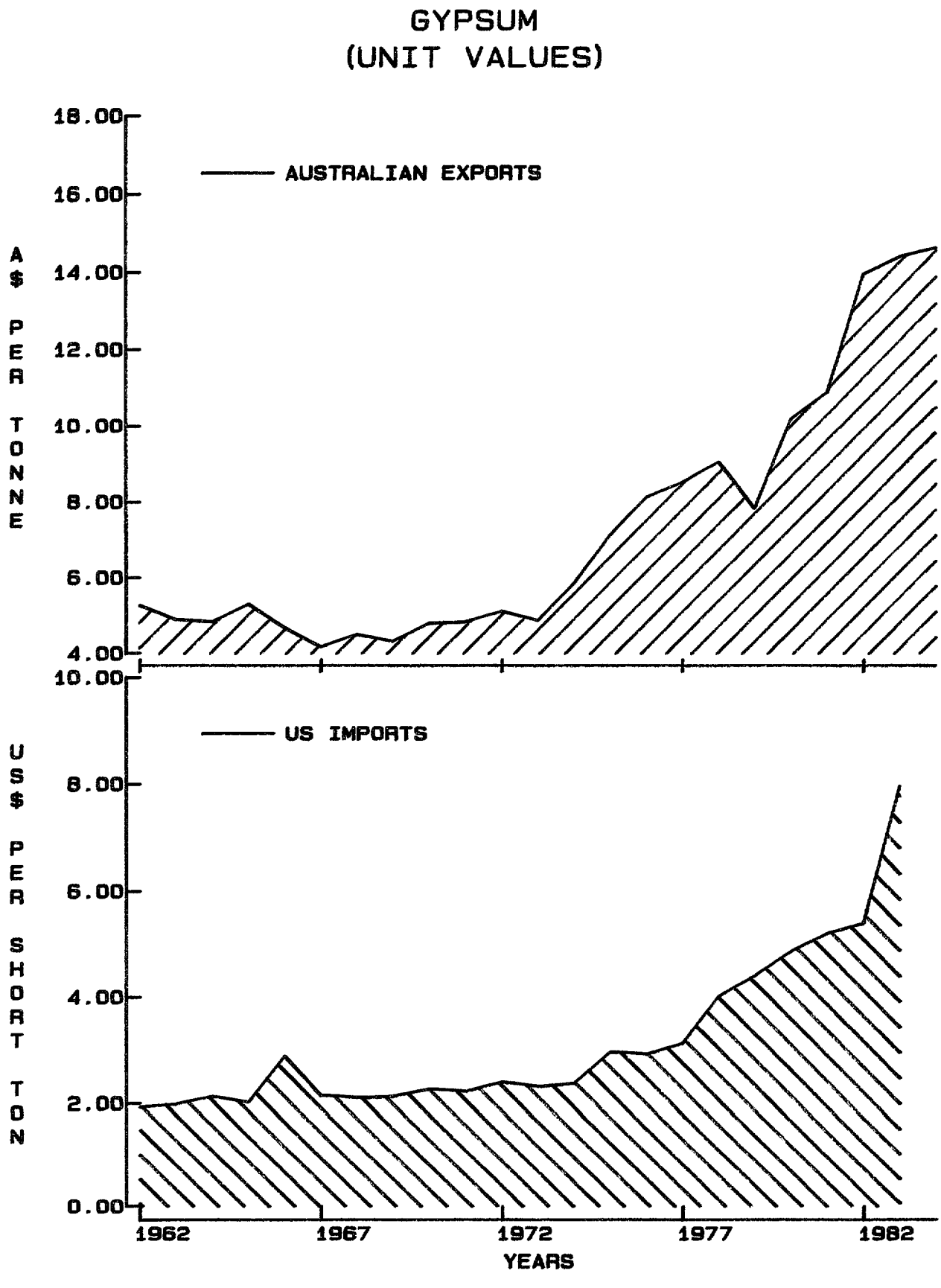

FIGURE 4: EXAMPLE OF GROUP PLOT
GYPSUM UNIT VALUES - AUSTRALIAN EXPORTS AND US IMPORTS

4.4 **Assistance**

For up-to-date information on additional features of IMPRI retrieval commands, enter IMPRI 'HELP'.

Help is available should any problems arise in the use of MAGIC or SUPERPLOT by telephoning any of the IP Sharp offices.

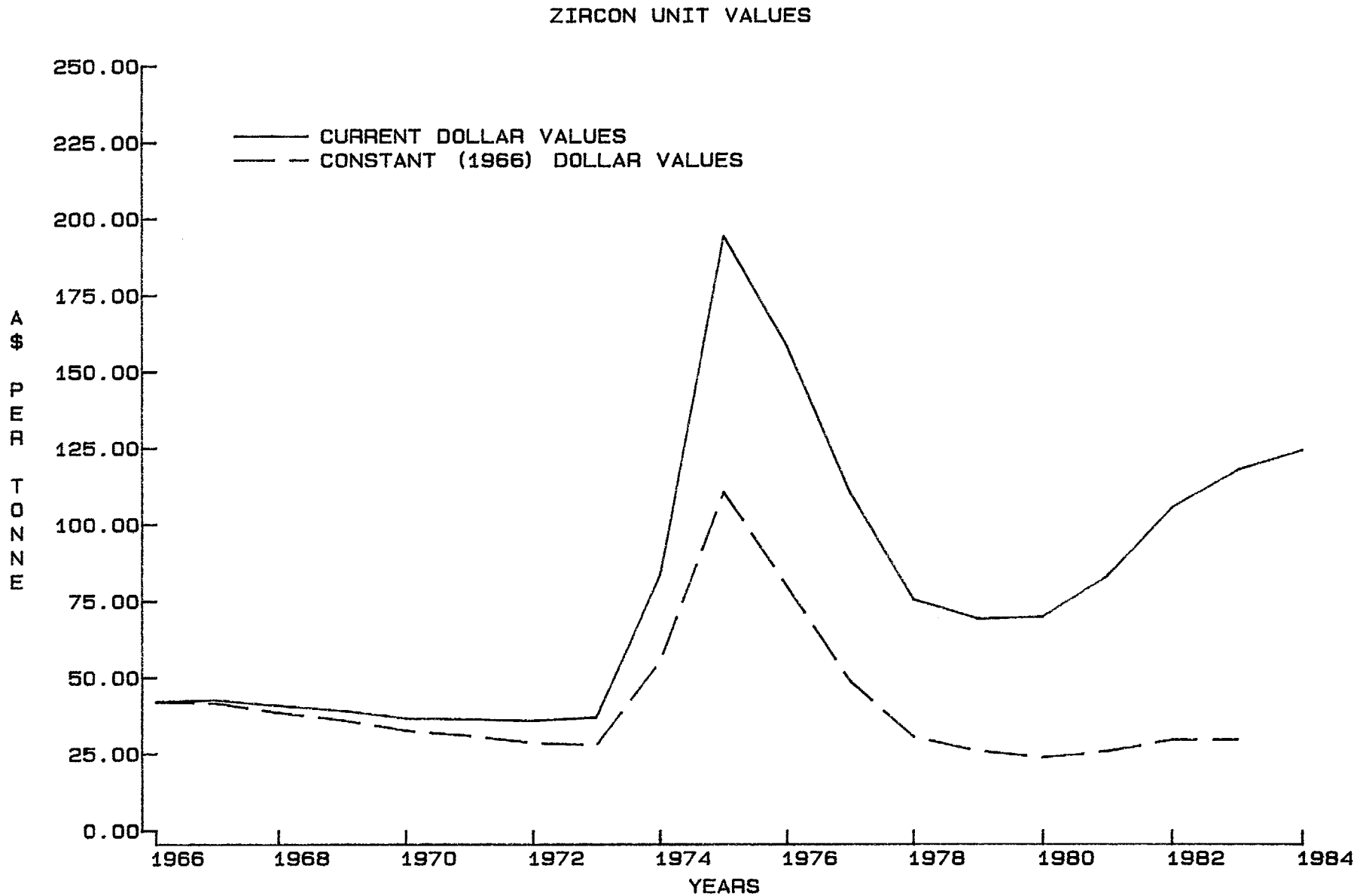

FIGURE 5: UNIT VALUES OF AUSTRALIAN EXPORTS OF ZIRCON