TANTALUM PRODUCERS INTERNATIONAL STUDY CENTER

QUARTERLY BULLETIN ISSUE No. 9 FEBRUARY 1977 FIRST QUARTER

Seventh General Assembly - Details

The Seventh General Assembly will be held in Winnipeg, Manitoba to afford to members the opportunity of visiting the operations of the Tantalum Mining Corporation of Canada Limited (Tanco) at Bernic Lake.

In order to reduce the total time required and to permit participants to make travel connections (at Toronto, New York, Vancouver, San Francisco, Los Angeles, etc.) on the second day, the Tanco visitation will be on Tuesday, May 3, and the General Assembly on Wednesday, May 4. This necessitates arrival on the evening of Monday, May 2, staying two nights at the Winnipeg Inn, a Western Hotel, phone : (204) 957-1350; telex : 0758-7524.

Forty rooms have been blocked at the Winnipeg Inn to be held for participants until April 15. Members should refer to their participation in the T.I.C. meeting when making reservations. Please also notify the office of National Resources Trading Inc. (NRT), 576 Fifth Avenue, New York, N.Y. 10036; phone (212) 765-2680; telex : ITT 420213/WU 12-6668 that reservations have been made and that participation in the Tanco visit is desired.

A comfortable bus trip to the mine of about 110 miles (mostly over paved highway) has been arranged. The bus will depart from the Winnipeg Inn at 9:30 a.m. on Tuesday morning, May 3. There will be a brief stop en route at the company's housing facilities at Lac du Bonnet for lunch at 12:30. Mine and mill visits are scheduled in three groups of 10-12 people each at 1:30 p.m. The bus will leave Bernic Lake at 4:45 p.m. arriving back at the Winnipeg Inn at about 7:00 p.m. A dinner is scheduled at 8:00 p.m. in lieu of customary lunch which follows the General Assembly when meeting in Brussels.

The Assembly is scheduled for Wednesday, May 4 at 9:00 a.m. and will terminate no later than 12:30 p.m. allowing for early afternoon departures from Winnipeg. The highlights of the meeting will be the presentation by Mr. Maguire, who has generously agreed to discuss questions from the floor, and the planning of the attendance, program, and funding of the General Symposium on Tantalum to be held in Rothenburg ob der Tauber, West Germany, in the spring of 1978.

As has been the custom, the T.I.C. Assemblies are normally attended by one delegate for each member company (the present membership, including expected new members, stands at 28-30). In order to have a productive meeting and because of the mine visit, it is expected that this rule will be followed again. Exceptions, however, are possible for members and expected members to the extent that accomodations are available. In this case, it is imperative that the office of NRT be advised not later than April 15.

The weather in Winnipeg in early May is normally spring-like, but can vary from quite cold to reasonably warm. The mine surface area and the underground workings are reasonably clean and dry. Casual clothes and protective overshoes will suffice. Hard hats will be provided.

General Symposium on Tantalum.

Tentative plans for the General Symposium on Tantalum to be held in the spring of 1978 at Rothenburg ob der Tauber, West Germany, call for arrival on the evening of May 3, the Symposium meetings on May 4, a visit to the town of Nuremberg and the plant of Gesellschaft Fur Elektrometallurgie (GFE) on Friday, May 5. After a dinner hosted by GFE, the group will return to Rothenburg where the Symposium will be terminated on Saturday morning.

Rothenburg is a small, lovely medieval town suitable for complete relaxation. Participants in the Symposium may wish to remain for the balance of the week-end. The Secretariat of the T.I.C. is securing a block of 100 rooms in two fine hotels in Rothenburg. The earliest possible advice as to participation of the members of T.I.C. and other interested parties is desireable. This advice should be received by the time of the General Assembly in Winnipeg.

The General Symposium on Tantalum will be open to all interested parties and not limited to members of the T.I.C. The program will provide the first professional gathering ever devoted solely to the tantalum and niobium business.

T.I.C. SEVENTH GENERAL ASSEMBLY

The Seventh General Assembly of the T.I.C. will be convened at 9:00 a.m. on May 4, 1977 in Winnipeg, Manitoba, Canada. The meeting will be held in the Winnipeg Inn. All members will be represented and prospective members have been invited.

The Agenda for the meeting will be :

1. **Approval of Minutes.**
2. **Report of Committees.**
   a. **Executive and Membership.**
   b. **T.I.C. Bulletin.**
3. **Financial Report for 1976.**
4. **Production Statistics.**
5. **Continuing T.I.C. Program.**
6. **General Symposium on Tantalum, Spring 1978.**
7. **Presentation : "Technical Approach to Economic Forecasting" Mr. David E. Maguire, General Manager, Components Department, Union Carbide Corporation.**
8. **Eighth General Assembly - Location and date.**
9. **Other matters.**

The General Assembly will be preceded on Tuesday, May 3, by a trip to the Tantalum Mining Corporation of Canada at Bernic Lake to visit and inspect the mining and mill operations there.

Interested prospective members wishing to attend the Seventh General Assembly should contact Mr. H. Becker-Fluegel, President of T.I.C., care of National Resources Trading Corp. Inc., 576 Fifth Avenue, New York, N.Y. 10036, U.S.A.; telephone : (212) 765-2680; telex : ITT 420213/WU 12-6668.

The tantalum resources of Brazil

Until the last few years, Brazil, as a source of useable material for the tantalum processing industry, has consistently provided from 25 % to 35 % of the free world supply. The first production of significance began in 1941 in response to the needs in the United States to produce material and equipment for the military effort of World War II. By 1943, Brazilian production was supplying over 50 % of the world's tantalum. When, at the end of 1944, it was found that adequate supply existed to cover the war needs, Brazilian production dropped rapidly to less than 20 % of the peak 1944 level.

Very low production, ranging from 3 to 25 m.t. Ta_2O_5 content, continued until the mid-1950's. Then the purchase of tantalite for the U.S. National Stockpile again inspired increased output. With the achievement of the tantalum stockpile objective in 1959, producion again leveled. Since that time, the Brazilian output has generally followed the pattern of world demand, providing an average of about 30 % of the total supply. The apparent depletion of major reserves, however, has resulted in a drop from 1973 onward such that Brazil now produces only 16 % to 18 % of the total tantalites sold in the free world.

From 1941 to the present, the Brazilian production has provided approximately 2,188 m.t. of Ta_2O_5 contained in tantalites and columbites. Prior to 1955, most of the concentrates came from the Paraiba-Rio Grande do Norte area in Northeastern Brazil. Since that time the major portion has been derived from the pegmatites and adjacent placer deposits in southern Minas Gerais in the southeastern portion of Brazil.

THE NORTHEAST REGION

This region, which includes the States of Permanibuco, Rio Grande do Norte, and Paraiba, is characterized by tens of thousands of pegmatite dikes, which, because they have resisted erosion, protrude as high as 100 meters above the surrounding areas. There are two types of dikes :

1. **Homogeneous dikes** - Tabular and narrow, varying from one to two meters in width and often several hundred meters in outcrop length. There is no internal differientation and the mineral distribution is quite uniform throughout. Although these dikes usually contain tantalum, the concentration level is so low that they have not been economic sources.
2. **Heterogenous dikes** - Lens shaped bodies as large as 500 meters wide in outcrop size. There is definite internal zoning generally very pronounced and easily distinguishable. The outer two zones are essentially free of tantalum mineral, but the third zone is predominantly feldspar crystals in which beryl, lithium, columbite, tantalite, and microlite minerals are found. Many of these dikes are large enough to have been mined economically for minerals.

During World War II, the dikes of this area provided the tantalite exported from Brazil. Semi-mechanized mining was used. Since that time, the periodic working by primitive hand mining, when market prices were high enough to inspire such, has resulted in a mass of surface debris which effectively masks the zoning and makes it now difficult to evaluate the remaining mineral potential. Extensive cleaning of the exposed dikes will be necessary before a useful survey can be made. The successful production in the past leads to the conclusion that additional tantalite can be derived from the heterogeneous dikes. The vast number of homogenous dikes also represent a possible resource for future development. Increased demand for beryl and lithium minerals would contribute to the development.

From 1941 through 1945, the northeast region produced 660 tons of tantalite-columbite concentrates. Individual lots ranged from 30 % to 67 % Ta_2O_5 and 15 % to 33 % Nb_2O_5. The contained Ta_2O_5 has been over 300 tons. At present, individual prospectors hand-cob some tantalite but there is no systematic operation.

THE SOUTHEASTERN REGION MINAS GERAIS

Although tin mining began in Minas Gerais in 1942, it was not until 1954 that the tantalum mineral potential was truly recognized. There is an extensive pegmatite district of about 1200 square kilometers located near the city of Sao Joao del Rei, about 125 km south of Belo Horizonte. The deposits are in alluvial gravels and weathered pegmatites containing cassiterite, spodumene, tantalite, columbite, and djalmaite (a mineral similar to microlite). The Nazareno pegmatite in this area, a dike about 1,700 meters by 30 meters in outcrop size, has been the principal source of the tantalum and tin minerals. Originally, the pegmatite output ran about 0.80 kg of mineralization per cubic yard in a ratio of three parts of cassiterite to one part of combined tantalite and djalmaite. The extensive working during the past twenty years, however, has exhausted the better reserves and the ore now contains only 0.20 kg per cubic yard in a ratio of two parts of cassiterite to one part of tantalum minerals. Thus the actual content of tantalum mineralization has declined from 0.20 kg to 0.06 kg per cu. yd. The reserve is being rapidly depleted, particularly the djalmaite portion.

OTHER AREAS

Although there are vast areas of Brazil which have not been explored, some of the current tin producing areas could be sources of tantalite. In the State of Goias, cassiterite deposits are similar to those in Minas Gerais to the southeast. More than 2,000 hand-pickers, known as garimperios, are engaged in the recovery of various minerals. During World War II, small quantities of tantalite concentrates were produced from the diamond-gold alluvial gravels in Amapa, north of the Amazon river along the Atlantic Coast.

The far western state of Rondonia is the site of the greatest tin concentrate production. There are small alluvial deposits containing tantalite in one area near the Bolivian border. These deposits have not been worked as they are too small for mechanized mining. The government restricted mining to mechanized operations in 1971 with the expectations that tin production would increase. After four years without great success, Rondonia was again opened to hand mining late in 1975. As a result, particularly because of higher tantalite prices, it might be expected that some tantalite will be produced.

RESERVES

The only officially listed reserves are those in Minas Gerais. In 1973, the National Department of Mineral Production officially listed proven reserves of 43,383 metric tons with indicated reserves at 72,620 tons. Although grade is not specified, these reserves could well contain up to 20,000 tons of tantalite and djalmaite.

No information is available on the reserves of Northeastern Brazil. In view of the past production from only a relatively few of the pegmatite dikes in the region, it must be assumed that the thousands of unexplored dikes provide a vast reserve waiting to be tapped.

SUMMARY

Brazil has been one of the major source countries for tantalum containing concentrates. Although currently worked deposits are approaching depletion, output can be expected to continue and possibly even increase as a result of world demand leading to higher tantalite prices. Development of remote resources, even those previously worked as in the Northeastern section, will require the establishment of an infrastructure and the investment of large amounts of capital.

The producing history of Brazil roughly compared with world production of tantalites and columbites (based on contained tantalum used by the tantalum processing industry) follows :

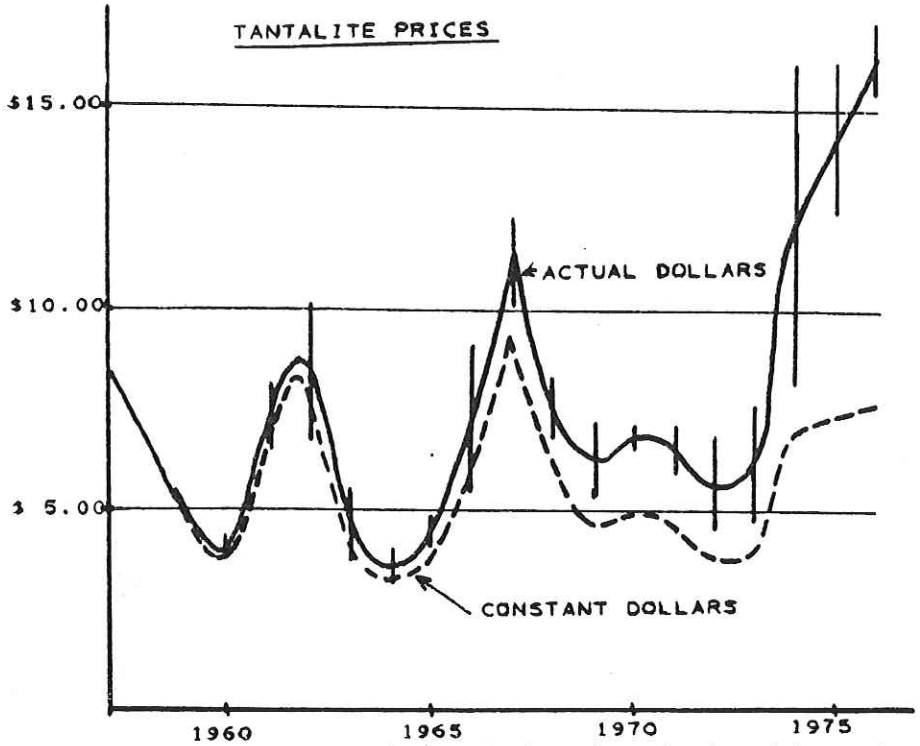
Period or Year	Brazil m.t. Ta_2O_5	Approx. Relation to World Production
1941-1945	412	55 %
1946-1950	74	15 %
1951-1955	109	10 %
1956-1960	327	18 %
1961-1965	280	25 %
1966-1970	541	23 %
1971	111	26 %
1972	114	31 %
1973	51	13 %
1974	81	16 %
1975	88	18 %
1976	86 (est)	17 %

The effect of the depletion of Minas Gerais deposits is evident in the output since 1973.

Twenty years of tantalite prices

During the past twenty years, the prices of tantalite have had a regular cyclical pattern with peaks more than double the minimums. With each cycle, however, both peaks and minimums have been higher than the preceding cycle, resulting in a continuous upward trend. It must be recognized that some of the continual upward trend results from inflationary trends.

During the 1940 decade, tantalite prices varied from $2.00 to a high of $3.50 in a cyclical pattern. Then, in the mid-1950's, as a result of the drive to obtain tantalite for the U.S. National Stockpile, tantalite prices were over $10.00 per pound of oxide content. The variations in supply and market demand since that time have resulted in a repetition of two or three years of over-supply with lower prices followed by two or three years of over-demand with higher prices. The cyclical effect is shown on the exhibit as " constant dollars ». The spread for each year is represented by a vertical line. The prices used are for the 30 % grade tantalite as this represents the larger part of the supply compared to the 60 % tantalite.



Most of the apparent increase in tantalum market prices is inflation effect. Because two-thirds of the tantalite produced is consumed in the United States, the inflationary effect can be evaluated by applying the buying power of the U.S. dollar to the actual prices. The dotted line on the exhibit demonstrates what the price of 30 % tantalite would have been if there had been no inflation since 1957. Thus the price in 1976 is at the same level as the peak annual averages of 1957 and 1962 and is slightly under the peak average of 1967.

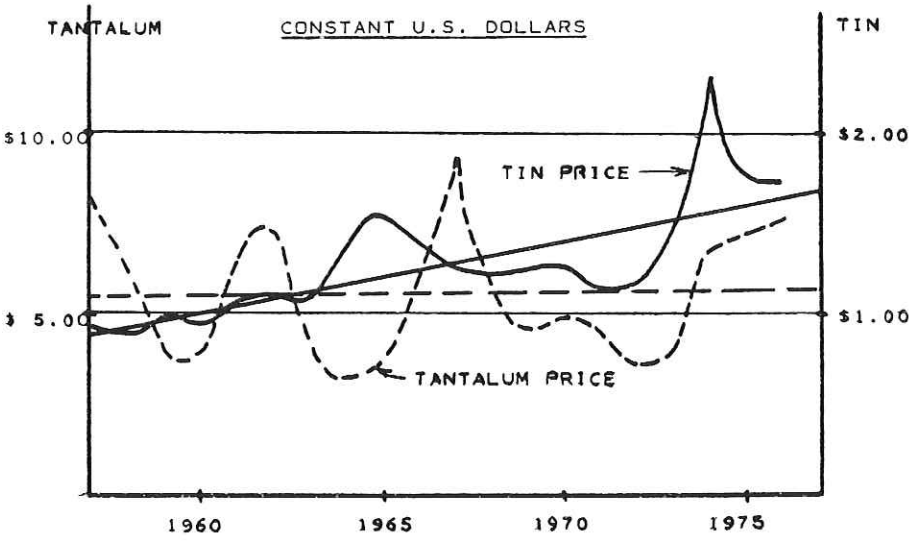
The regular cyclical downward trend after the high of 1967 was arrested in 1969 because of the increased demand for capacitors in the consumer segment of the electronic market. At the same time, the Bernic Lake mine of the Tantalum Corporation of Canada came into production, preventing a rapid rise in prices and providing stability during 1970 and 1971. The combination of the electronic market recession in 1971 and the sale of accumulated tin slag inventories extended the period of stability through 1973.

The shifting of inventories from producers to processors appears to have played an important part in the extreme variation of market prices. At those times in which demand has been increasing, the efforts of processors to obtain more material has led to the building of inventories in their hands as the market demand for tantalum products began to decrease. Such resulted in excess inventories which had to be worked off, decreasing the apparent requirements for tantalum source materials below the level of actual processing. To the producers who, during the period of rising prices, had increased their output, the sudden failure of demand for their product led to accumulation of inventories. In an effort to dispose of these, they were willing to sell at lower prices. Since decreasing prices were usually sustained for a period of two or three years, cutbacks in production left inadequate supply when demand again increased after the processors had reduced their inventories to minimum working levels. Due to the advent of Bernic Lake mine and the development of capability by processors to use volumes of low grade slags, very large inventories of material were available at the beginning of 1973 when the capacitor requirements grew rapidly. Without these inventories, the supply of material from the processors would have been totally inadequate to meet the market demand.

In 1974, however, the market demand exceeded production and remaining inventories, even though the supply was supplemented by sales from the U.S. National Stockpile. Prices jumped upward. Because of the recession, the market softened in 1975 with some decrease in prices. But concerns about political problems in some producing countries, plus sizeable restrictions placed upon tin production by the International Tin Council, actually resulted in some decrease in the supply. Tantalite prices again firmed up at the 1974 peak level. As the market demand increased with the easing of the recession in 1976, the supply of tantalite could not meet the market demand and prices have continued upward.

During the same period, 1957 through 1976, the prices of 60 % tantalite have cycled in the same pattern as the thirty percent material. The average, however, has been $9.77, a little over two dollars more than the price of the lower grade. Until 1973, the cyclic curve has always led the 30 % curve by one year, indicating that the 60 % tantalite was a preferred material. During the last three years, however, the price increases of both materials have followed the same pattern.

A comparison with tin prices during the last twenty years shows the same cyclical pattern which seems to lead the price changes in tantalite by about two years. The second exhibit shows the prices for both commodities in constant U.S. dollars. Trend lines show that the constant dollar price of tantalite trend has increased by US$0.18 since 1957, about 3.2 %. On the other hand the tin trend line has increased by US$0.84 over the same period, about 88.7 %.



T.I.C. statistics for 1975

One of the original purposes of the T.I.C. is to collect statistical data from members and to make that data available to members of the tantalum community. Although it has taken some time to establish reporting procedures, data has now been accumulated for 1975.

Reports from 10 members whose production of tantalites and tantalum containing tin slags cover about 95 % of the production of all T.I.C. members. It is estimated that the reported data covers approximately 60 % of the world production. The data for 1975 in metric tons of contained Ta_2O_5 are as follows :

Period	Tantalite	Tin Slag	Total
1st Quarter	66	54	120
2nd Quarter	61	51	112
3rd Quarter	58	54	112
4th Quarter	73	60	133
Year Total	258	219	477

Use of tin slag increases

Inventories of low grade tin slags below 4.0 % Ta_2O_5 have been accumulated for some years as a result of ample supply of better grade source materials from producers and other inventories such as the U.S. National Stockpile. The total use of better grade inventories has led to the development of interest by processors in the remaining inventories of lower-grade material. These examples of activity have occurred during the second half of 1976 :

- Datuk Keramat Smelting in Penang has been known to have about 2,500 m.t. of slag containing 2.75 % Ta_2O_5 (about 150,000 lb. Ta_2O_5 content). After soliciting bids from a number of merchants and processors, DKS sold the slag to Philipp Brothers, reportedly for $2.05 per lb. Ta_2O_5, f.o.b. Penang.
- Kawecki Berylco Industries, Inc., a major tantalum processor, announced in October that they had arranged to have their large inventories of Malaysian slags processed in West Germany into an upgraded product by Hermann C. Starck Berlin. Using the U.S. Bureau of Mines data, it is estimated that Kawecki has about 28,000 m.t. which, if it is assumed that they are at about 3.5 %, would contain about 2 million pounds of Ta_2O_5. The period of time over which these slags would be used was not reported.
- The smelter at Butterworth, Malaysia, of the Straits Trading Co. has had a slag inventory of 5,000 m.t. the Ta_2O_5 content of which ranged by lot from aboutt 2.5 % to 3.0 %. In November, Philipp Brothers was reported to have purchased about one-half of this inventory at $2.45 per pound Ta_2O_5 f.o.b. Penang. The contained Ta_2O_5 calculates to be about 150,000 lb.

Thus a total of 2.0 million to 2.5 million pounds of Ta_2O_5 has been added to the supply of tantalum from sources which in recent years have not been used. It is probable that this addition will assure adequate material to meet market demands through 1977 into 1978.

Treibacher Chemische Werke A.G.

Treibacher Chemische Werke A.G. was founded in Treibach, Austria in 1898. Treibach is located in southern Austria near the Yugoslavia border about 200 km southwest of Vienna. A second factory is located in nearby Seebach. Together with the sales office in Vienna, 1,300 people are employed in Austria.

Originally a producer of rare earth compounds for the glass industry, Treibacher expanded their product line in 1903 to include flints and again in 1917 to include ferro-alloys. Today the products range from ferro-alloys for the steel industry, to abrasives, detergents, and hard metals. Shipments per day average of all products about 200 tons, 80 % of which is exported to 80 countries. Total sales reached $108 million in 1975.

In 1958, Treibacher expanded their product line to include optical pure tantalum oxide produced in a pilot plant. Large scale production began in 1960 and it has been increased continuously. In order to realize better utilization of capacity, production of niobium oxide has been added. The initial market for these oxides was the glass industry.

Further diversification added two new products, tantalum carbide and niobium carbide. Industrial production began in 1967, and the capacity was tripled in 1970. Imported tantalites are digested with hydrofluoric acid. The tantalum and niobium are extracted from the acid solution using methyl-iso-butyl ketone. The steps of separation and precipitation of the oxides follow the standard procedures used throughout the tantalum industry. From the oxides, tantalum and niobium carbides are formed using vacuum furnaces for reaction.

The Technical Department provides three functions : research and development, quality control, and customer technical service. A number of new materials have been developed in the last two years as a result of the research efforts. Strict quality control guarantees the high quality of the Treibacher products using the most modern methods to assure that both incoming materials and outgoing products meet the stringent specifications. Technical service is provided to customers utilizing the findings of the research efforts to assist them in more satisfactory use of the products purchased.

T.I.C. « Bulletin » is two years old

The current issue of the T. I. C. " Bulletin " is the ninth quarterly issue, signifying the completion of two years of publication. Distribution has become widespread and the " Bulletin " has become a well established authority in the tantalum information field.

In addition to well over one hundred copies circulated each quarter by the twenty-two members of T.I.C., copies are sent to all potential members, seventy-three companies and organizations, and seven publications. Total circulation is currently about two hundred copies each quarter. The distribution is widespread, reaching at least twenty countries in all continents. Although readers are primarily people associated with the industry, copies are also sent to government agencies in Australia, Europe, and North America.

Requests for additions to the distribution list should be directed to Mrs. J. E. Goodyear, Secretary, at the Tantalum Producers International Research Center, 1 rue aux Laines, 1000 Brussels, Belgium.

TANTALUM PRODUCERS INTERNATIONAL STUDY CENTER
1. RUE AUX LAINES - 1000 BRUSSELS

PRINTED BY PUVREZ
59, av. Fonsny, Brussels