fractionation lines in three-isotope plots. The trends observed as silica content decreases are: heavier isotopes of oxygen are enriched, heavier isotopes of silicon are depleted. Since the silicon isotope data do not follow the trend of vapor fractionation, we conclude that the isotopic patterns in the bediasites were not due to vapor fractionation, but rather reflect variations in the source materials.

Table 1

Bediasite	SiO_2 wt %	$\delta^{18}O$ ‰ (SMOW)	$\delta^{30}Si$ ‰ (NBS 28)
TX 1	80.4	8.19	−0.14
ME 2384	78.5	8.52	−0.20
TX 3	74.2	9.19	−0.43
TX 2	73.4	8.88	−0.46
TX 4	73.3	8.75	−0.10

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THE PENWELL METEORITE REVISITED

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In the abstracts of the 44th Annual Meeting of the Meteoritical Society a new stony-iron meteorite found at Penwell near Odessa, Ector County, Texas was reported. This meteorite was characterized by a high concentration of cliftonite graphite.

Additional study of this meteorite shows that the non-metallic phases are similar to those found in silicate inclusions of the Odessa iron meteorite. Table 1 compares the analysis of some minerals from Penwell with those reported for Odessa and those analyzed in samples identified as Pseudo-Penwell. Pseudo-Penwell is a sample of several stones collected after Penwell was first reported. It was made available to us by James DuPont. The original Penwell and the Pseudo-Penwell have different macroscopic and microscopic characteristics. Penwell appears to be more coarsely crystalline with a granoblastic texture than Pseudo-Penwell or Odessa silicate inclusions.

Table 1
A comparison of mineral compositions in meteorites from the Odessa area

	PENWELL	ODESSA Silicate Inclusions	Pseudo-Penwell
Olivine (Fa)	4.9 ± .3	3 - 4	6.4 ± .5
Plagioclase (An)	11.8 ± 2.2	9 - 14	15.6 ± 1.4
Orthopyroxene (Fs)	6.6 ± .4	6 - 8	6.9 ± .2
Kamacite (% Ni)	4.6 ± .3	4.5 (inclusions) 6.3 (matrix)	6.9 ± .2

It thus appears that it is possible that the parent meteoroid of the Odessa iron contained various inclusions which may have broken free during entry and been scattered over a moderately large area. Different inclusions experienced differing histories in the parent body as indicated by the textures observed.

EXTREME Pu-U AND POSSIBLE Pu-REE FRACTIONATION IN UNEQUILIBRATED CHONDRITES

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The purpose of this study is to understand actinide chemistry in chondrites and to evaluate unequilibrated chondrites for either Pu/U or Pu/Nd chronology. Using fission track radiography for

Nadiabondi (H5) (Murrell and Burnett, 1982), Dhajala (H3,4), Bremervörde (H3), Sharps (H3), and Tieschitz (H3), we find that U is primarily located in chondrule glass (50-500 ppb, average of ~ 100 ppb). Apatite from the unequilibrated chondrites contains 150-200 ppb U while whitlockite contains < 17 ppb [low compared to type-6 chondrites which have 1-6 ppm U in apatite and ~ 200 ppb in whitlockite (Pellas and Storzer, 1975)]. Nadiabondi phosphates are intermediate (Murrell and Burnett, 1982). These observations suggest that the phosphate U content increases with petrologic type (Pellas and Storzer, 1975), with U obtained from chondrule glass during metamorphism.

Etched thin sections of Bremervörde, Sharps, and Tieschitz show no significant enrichment of tracks in olivines adjacent to chondrule glass. A conservative upper limit is 0.1 ppb ^{244}Pu in glass at the time of olivine track retention. If Pu and U are entirely in glass, olivine is required to retain tracks ~ 200 m.y. after chondrule formation. With no other evidence for an extensive high temperature history, it seems more reasonable to conclude that Pu/U in glass is depleted by at least a factor of ~ 5, possibly greater. On the other hand, phosphate-olivine and phosphate-pyroxene contacts observed in Bremervörde do show significant track enrichments which indicates that the ^{244}Pu content of whitlockite was more than 100 ×'s that of the glass at the time of track retention in olivine. In addition, etched phosphates (30 sec., 0.25% HNO_3) also give results consistent with Pu concentration in phosphates: In the SEM, Bremervörde (and Tieschitz) whitlockites have random surface pits ($7 \times 10^7/cm^2$) which could be spallation recoil tracks, but given the relatively high densities, these are perhaps better interpreted as annealed ^{244}Pu fission tracks. The density of long tracks (> 1 μ) in replicas is $3 \times 10^6/cm^2$. Replicas from St. Severin whitlockite counted in the same way give $6 \times 10^6/cm^2$, in agreement with literature ^{244}Pu track densities [e.g. Pellas and Storzer, 1975)]. Although quantitative interpretation of track data in terms of Pu concentrations is difficult in all meteorites, our phosphate track results qualitatively indicate ^{244}Pu concentrations comparable to phosphates in equilibrated chondrites. It appears that Pu is incorporated into chondritic phosphates early as they form and/or grow in size during metamorphism (Murrell and Burnett, 1982); whereas U remains in glass during the early stage. This conclusion is definitely valid for Nadiabondi [20 ppb Pu in whitlockite (Kirsten *et al.*, 1978) and Pu/Nd = 1.8×10^{-4}, weight (Chen and Wasserburg, 1981), identical to St. Severin]. Nd has followed Pu into the phosphates of Nadiabondi and St. Severin, but, possibly not for unequilibrated H-chondrites. Chondrules from unequilibrated chondrites generally show REE enrichment over C1 levels [e.g. Grossman and Wasson (1982)]; however, many Richardton (H5) chondrules are depleted with positive Eu anomalies (Evensen *et al.*, 1979) which is a pattern complementary to phosphates from Richardton and type-6 chondrites (Ebihara and Honda, submitted). This suggests REE migration from chondrule to phosphate during metamorphism (Evensen *et al.*, 1979). Sm is correlated with Al in unequilibrated chondrules (Grossman and Wasson, 1982); so the REE might be with U in glass. Alternatively, the REE carrier may be phosphates within chondrules; however, chondrules are depleted in metal and phosphates. Thus, REE and U in unequilibrated chondrites may be in glass with Pu in phosphates.

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Rb-Sr ISOTOPIC AND REE ABUNDANCES IN THE CHASSIGNY METEORITE

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Origin of the SNC meteorites has been debated as to whether meteorites were derived from small planetary bodies or from large planetary bodies. In a recent study, we present the Sm-Nd, U-Pb isotopic and elemental data which were considered to be consistent with planetary origin of