RECORD

Near Field Investigations
Field Work at Yucca Mountain
– page 3; ~~complete~~ CWM 9/21/94
Complementary notes in
CNWRA control 121
(David Pickett)

This book also contains information on underground worker training including first aid (p. 27) and radiation worker training

6/18/96

Field work at Yucca Mountain area 6/96.

General Employee Training for Murphy AM, badge received on 6/17/96 and red clip for Area 25 access granted after training.

After acquiring a radio, first aid kit and fire extinguisher at the Yucca Mountain Field Operations Center, travel to Rainier Mesa.

Tuff section observed in road cuts over Rainier Mesa

Sample NFA96-01 collected on the east side of the summit pass of the main road by Rainier Mesa. Samples are various chalking and crumbly, fairly hard and also chalky in places and exhibiting a green to white

6/18/96

— For continuation from page 3 go to page 6 —

6/20/96 Sample NFA96-03 Margin of a lithophysal cavity of tuff with fine white crystals and larger (up to 1-2 mm) hematite crystals with nice facets.

NFA96-08 Site where fluorite-hematite-manganese oxide-calcite sequence was observed. Sample consists of thin (1 cm) tuff fragment coated with fluorite on one surface and calcite on the opposite.

NFA96-04: Calcite on fracture surface.

~~NFA96-05 Coarse calcite crystals on brecciated tuff~~ WJ 9/20/96

WJ 6 mm 6/20/96

NFA96-05 Fragments of calcite on tuff. One sample with greenish minerals covered by slickensides.

NFA96-06 Coarse calcite crystals taken near fault. High Cl-36 site

WJ 6 mm 6/20/96

6/18/96 color. All are ash-fall (?) tuffs, probably of the Tac_2 of the NTS geologic map: Ash fall tuff under Timber Mountain Tuff and related units. Location marked on 1:100,000 topographic map.

for Murphy

6/19/96 GET training was taken in Las Vegas on 6/18/96 AM. Underground safety instruction received at the FOC on 6/19/96. With Chad Glenn (USBC) and Nelson OConnor of a DOE contractor as an escort Murphy and Pickett rode the man train to the TBM which is at about 5700 m from the north portal at YM.

Rock there is very broken and may represent the splay of the Ghost Dance fault illustrated on page 8. There is a gap of relatively unbroken between this rock and the long zone of unbroken rock reported as a noticeable event in May? '96.

6/20/96

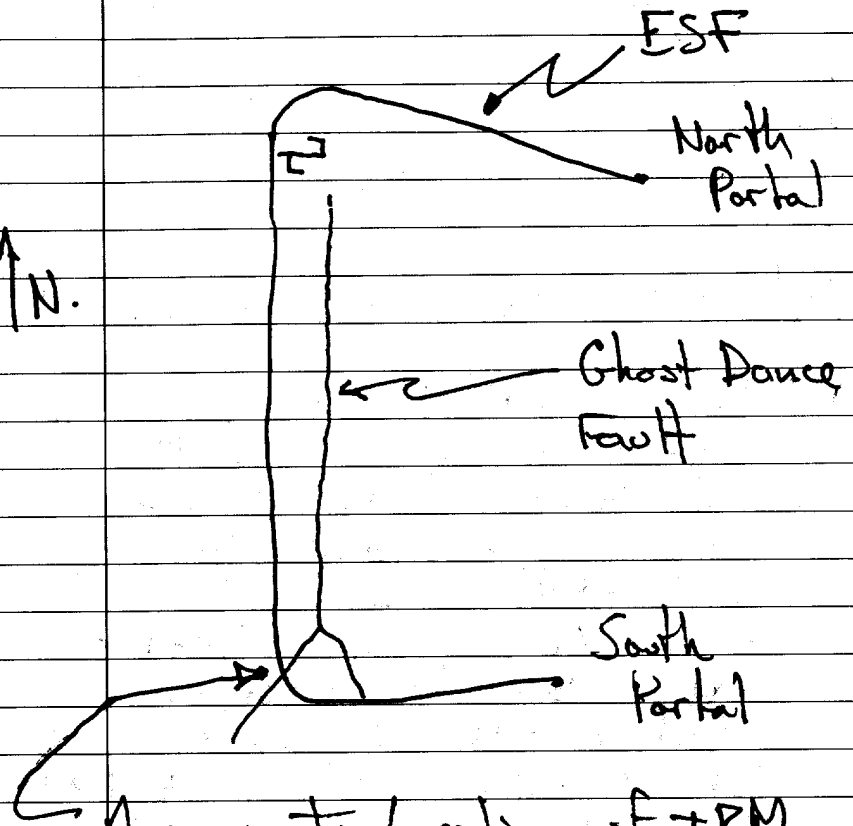
6/20/96 Chad Glenn made a telephone inquiry and determined that we could take modest rock samples from the ESF.

6/19/96 5602 - Mn/calcite fracture fill

Sample NFA96-02: fractured Topopah Spring Tuff w/ Mn and Fe on fracture surfaces. Fracture mapped at 54+24.4D with attitude 226/78 (strike/dip). Two photos taken by Chad Glenn. Much of the Fe oxide of limonitic color is derived from dripping from rock bolt emplacements in the roof. Oxidation is rapid and will clearly affect near-field water chemistry.

CGM 9/20/96

6/19/96 Map of ESF and Ghost Dance Fault surface expression



CWM 6/19/96

6/19/96 NFA96-03 Crystals in cavity at 53+90 Several photos taken. see description page 4

4857.40 - NFA96-04 see pg. 4

Sum 9/18/96

NFA96-05 @ 35+45.4 near Sundance Fault. high Cl-36 site, ~~Calcite~~ ~~rich, tuff fragments, one with stricken sides~~ CWM 9/20/96 CWM 9/20/96

see pg. 5 4/CWM 9/20/96

14+89.58 NFA96-06 see pg 5

Altered zone base of PTn → NFA96-07 Brown friable altered tuff. Site described in recent literature as a "fossil fumerole"

NFA96-08 Flourite on tuff fracture surface

6 CWM 9/20/96

6/20/96 General observations from ESF.

The southern half of the main drift has many fractures and minerals on many surfaces, but little or no "alteration" of the tuffs. It seems reasonable the fluorite, Fe oxide, Mn oxide coatings are fairly old, but some calcite - the last ppt. may be young. There is no evidence for hydrothermal alteration except in the "fossil fumerole", from brief field investigations. Water has traveled in many fractures as indicated by calcite, but many fractures show no secondary mineralization. Unfractured rocks show no secondary minerals in general.

Larry Flint 6/20/96

6/19/96 UZ-7A pad site exposure of Ghost Dance fault: more fractured on west-side down-thrown block; more caliche in up thrown east side.

Scenario: East side is higher, sheds alluvium, permits infiltration and calcite precipitation in fractures to some depth. West side is lower, accumulates alluvium, does not permit fracture mineralization because of no net infiltration through alluvium. Both sides are eroded to show fractured west side with no calcite and less fractured east side with calcite.

Larry Flint 6/19/96

6/19/96 Calico Hills. 6/20/96

6/20/96 Reference CNWRA book 121 for location.

A series of samples was taken descending through the Topopah Spring toward the road and the Calico Hills exposure.

NFA96-09 White, hard silicified tuff

NFA96-10 Hard bedded 6/20/96 red silicified tuff with large red matrix areas containing gray quartz(?) crystals, some evidence of welding.

NFA96-11 Welded tuff, altered but not hard and silicified, contains pumice fragments, near base of Topopah Spring tuff.

6/20/96

6/20/96 NFA96-12

Orange colored block of Calico Hills unit: unwelded, weathered, but fairly hard with many varied inclusions and vugs.

Travel to just below Prow Pass. Calico Hills unit crops out in center of Yucca Wash and up to the pass.

Sample NFA96-13 is a zeolite tuff w/ pumice, quartz, mica; white in color this sample is relatively hard and may still contain a vitric component. Most rocks here seem highly zeolitized. Location marked on 7½' topo map.

6/20/96

6/20/96 NFA96-14 Base of Topopah Spring Tuff on SW side of Prow Pass near Broxton sampling sites. Rock is brown and contains glass fragments in pumice and matrix.

NFA96-15 Top of Calico Hills unit. Rock is pink and zolitic with many varied inclusions - nonwelded.

NFA96-16 Calico Hills some 10's of meters below contact: pink, hard, but low density zeolitized tuff with numerous inclusions

NFA96-17. Pink and white zeolitized tuff of Calico Hills unit taken near base of prominent exposures at head of Yucca Wash

NFA96-18 recorded in Pickett's book - another Calico Hills

6/20/96

6/20/96 NFA96-19 collected from a gap area east of another gap area in an area believe to be the "Pull-Apart Fault" described in C.A. Hall et al. 1995. Material is chalky deposit, similar to massive caliche, containing clasts of the black colored host carbonate rocks which are mapped as Papoose Lake Member of the Cambrian Bonanza King Fm. Marked on 1:100,000 Beatty topographic map.

6/21/96

Up fluorspar canyon from Beatty a new mine is being proposed, the daisy project. Reconnoissance there reveals a black silica rich and highly altered rock in altered welded tuff. A selection of the altered tuffs was collected.

6/20/96

6/21/96

NFA96-20 two samples of silicified tuff marginal to the zone of intense alteration

NFA96-21 An example of most altered rock: black, silica and iron rich, gossany rock: probably the gold ore!

NFA96-22 Apparently a (possibly) zeolitic altered tuff.

WT-7 drill pad and west side of Yucca Mountain examined from Solitario Canyon. See Pickett's notebook for details.

6/21/96

I have reviewed this scientific notebook and find it in general compliance with QAP-001 and there is sufficient technical information so that another qualified person could repeat the activity.

E. C. Pierce
1/7/97

4/8/98

4/8/98

Field trip w/ McKague at lead with Phil Justis, I. Stamatakos, R. Hill, S. Slothoff, and P. Lafemina to observe faults.

Written notes attached on a following page by McKague.

First stop at Cave Springs. Poor evidence for faulting. Springs produce a muddy area and surface flow like a slow filling bathtub.

Fault zone may occur uphill from spring and serve as recharge or diversion mechanism.

The site of the nuclear test producing Pu identified in colloids from groundwater 1.4 km distant and closer to a subsequent nuclear test was shown. Topography gently slopes from the source to the detection point.

Field trip guide attached to following page.

4/8/98

4/22/98

Field notes prepared by Larry McKague for 4/8/98.

FIELD TRIP TO VIEW FAULTS IN YUCCA FLAT AND PAHUTE MESA

4/8/98

STOP 1 - Cane Springs Faults

The Cane Springs fault zone is a northeast-striking left-lateral fault zone. It is considered to be part of Carr's (1971) Spotted Range-Mine Mountain structural zone. To southwest, there appears to be more fault displacement in the Salyer formation than in the younger Ammonia Tanks Tuff suggesting much of the displacement occurred prior to 11 my ago. The age of last movement on Cane Springs fault is difficult to determine because it is poorly constrained. In several places the fault is the contact between Miocene Tuffs (Wahmonie and Salyer formations 13 my Sawyer, 1994) and alluvium of various ages i.e., Pliocene, Pleistocene, and Quaternary. Some faults within the zone are mapped as lineaments or scarps on Tertiary or Quaternary surfaces. Photolineaments in alluvium northeast of Cane Springs were checked by Ekren (1972), but no displacement of alluvium could be detected in cross cutting washes. Diffuse seismicity is suggestive of activity along the fault. The 08/05/71 Massachusetts Mountain earthquake occurred near the intersection of a northwest trending structural lineament and a possible extension of the Cane Spring fault. However, this is highly speculative.

STOP 2 - Faulting at Syncline Ridge

Low angle fault on west side of Yucca Flat. Low angle normal fault complex faults are Deuonian carbonates.

STOP 3 - Carpetbag Fault

This fault was unknown but suspected prior to 12/70. Photo-lineaments and a prominent north-trending gravity high suggested the presence of the fault. Although the displacement appears to be normal right lateral displacement of 15 cm across a 1.2 m high scarp along left stepping en echelon cracks was observed. Average vertical displacement of Tertiary tuffs is > 600 m. Although there is as much as 2000 m difference in elevation of the Paleozoic surface across the fault, much of it could be topography on the pre-tuff Paleozoic surface.

Following the carpetbag event in 12/70, a graben developed on the downthrown side of the fault. The graben is up to 5 m deep and in excess of 600 m across. Although tectonic motion (strain release) probably occurred at the time of the Carpetbag test, as indicated by horizontal displacement. However, much of the vertical displacement was probably the result of compaction of poorly sorted course alluvium associated with rapid erosion off the gravity high (Fig. 1).

STOP 4 - This stop is at the top of the Area 17 hill where the base of the Rainier Mesa Tuff and older tuffs are exposed. At this location the Rainier Mesa ash flow apparently followed a valley cut into the old tuffs. The flow is incised into the Pre-Rainier Mesa bedded tuffs. The 1 inch thick dacite ash that marks the base of the Rainier Mesa Tuff in many areas is present at this exposure. The pre-Rainier Mesa Tuff consists of a number of thin, non to partially welded, ash-flow tuffs.

STOP 5 - At this stop the Boxcar Fault is exposed in a road cut along the Buckboard Mesa Road near the top of Pahute Mesa. The Boxcar fault is one of the major faults cutting the tuffs on Pahute Mesa. At this location Rainier Mesa Tuff and Trail Ridge Tuff occur on either side of the fault at the same elevation, a post-Trail Ridge Tuff (9 ma) displacement of more than 400 feet. The fault zone is 5 to 10 feet wide and filled with gouge and breccia. Also exposed at this stop is the youngest of the Paintbrush Tuffs, the Rhyolite of Benham.

Based on isopach data the source of the rhyolite lava is north of this stop near where the Boxcar Fault splits into the east and west branches.

STOP 6 - This stop was at emplacement hole U20ax. Because Area 18 was closed we could not stop at Scrugham Peak or Buckboard Mesa. This stop afforded an overview of Scrugham Peak to the southeast. Several people have proposed theories for the Buckboard Mesa lava and cindercone emplacement (chemically an andesitic basalt). Gene Smith (UNLV) proposed that this is an extension of the northeast striking alignment of the cinder cones in Crater Flat. An equally plausible theory is that the basalt was intruded along a deep fault (LANL) has suggested in private discussions that it is related to the Ammonia Tanks (?) caldera cutting, major N-S striking, normal fault system. From north to south this fault system could consist of the Kawich Valley fault, the Almendro fault, and the Scrugham Peak fault. A seismic refraction survey run by LANL in area 19 along the Pahute Mesa road shows up to 1.5 km of vertical displacement across this fault system in tuffs that predated the Rainier Mesa Tuff.

STOP 7 - This stop was in a barrow pit NE of U20ax. The barrow pit is located between the Duryea and an unnamed fault. The excavation exposed 30-40 feet of bedded tuffs between the base of the Pahute Mesa Tuff and the top surface of the welded Ammonia Tanks Tuff ash-flow tuff. Bedded tuff expected to be present in this interval include the Rocket Wash Tuff, the Volcanics of Fortymile Canyon and possibly the upper non-welded top of the Ammonia Tanks Tuff. Many minor faults are in evidence. A portion of the unnamed fault surface is exposed along the eastern wall of the barrow pit. It is obvious from slickensides and the overall shape of the fault surface that movement along this fault has been nearly vertical.

STOP 3

FIG 1

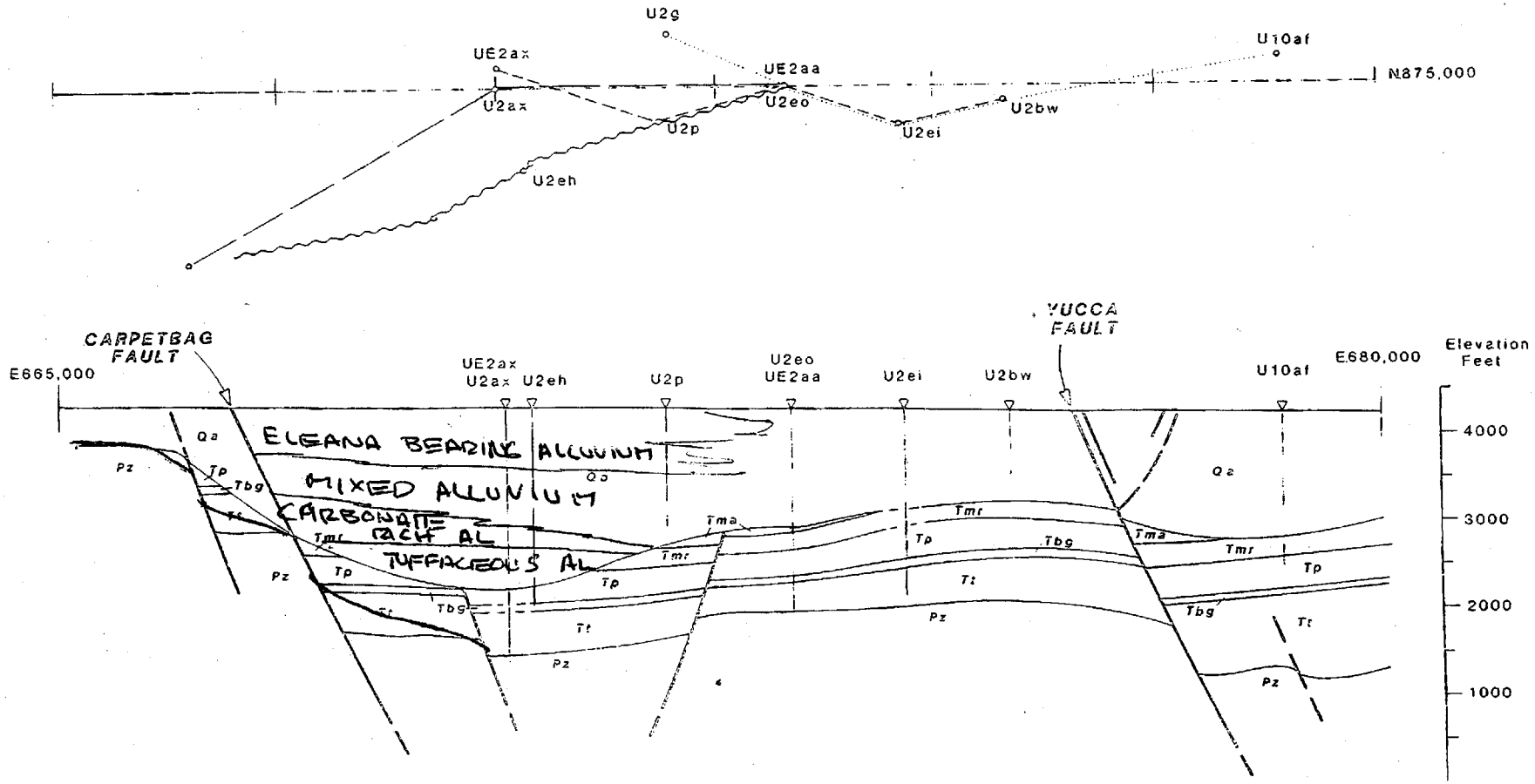


Figure 6.--Plan view and geologic cross section of part of the section along Nevada Coordinate N. 875,000 (cross hatches on fig. 3). Location of lines of section for figure 5 drill holes U2ax (long dash), U2ei (dots), U2eo (short dash), and U2eh (wavy line) shown in relation to Nevada Coordinate N. 875,000.

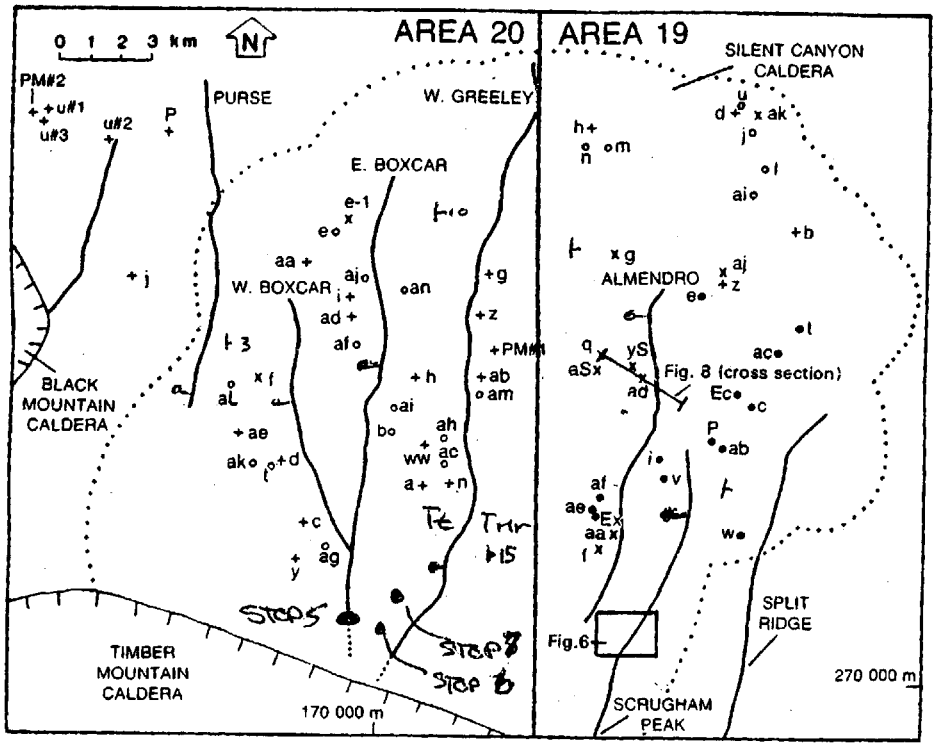


Figure 1 - Location of drill holes, calderas, and major surficial faults of Pahute Mesa. All faults shown have normal displacement, down to west. Symbols indicate progress for petrographic and chemical work: (●) complete; (x) nearly complete; (+) partly complete; (o) none. Prefix U-19 (Area 19) or U-20 (Area 20) omitted on drill hole designations.

4/9/98

Observations made of rocks on ridge east of Paiute Ridge on eastern edge of NTS. This area was described by Matyskiela (and Packer in Nevada State report) in Geology, v.25 p115, 1997, to represent an analog to the Yucca Mountain near field. An intruding mafic sill causes local, e.g. meter scale, contact secondary welding of enclosing silicic tuffs. In places the tuffs are silicified. At the point identified by Matyskiela and Packer, to represent an area of alteration analogous to that adjacent to the sill in the center of the arc of outcropping sill,* the altered zone overlies a vitrophyre - alteration could be due to gas phase alteration during cooling of tuff rather than by sill intrusion. Seismic data for a shallow flat lying sill reported by

MM 4/9/98

Matyskiela could be evidence of the vitrophyre instead. Later two alternate models/interpretations offered by Britain Hill. Some seismic lines may have been below the vitrophyre stratigraphically, however.

* This site is noted on map (page 24) as 1, vitrophyre and alteration site.

Sample PR001 was taken from orange-red tuff about 3 meters west of the vitrophyre. It has two surfaces, roughly perpendicular that bounded fractures. One contains white (calcite-opal?) fill, the other was a weathering surface but retains some features similar to the other. Rock appears to be somewhat silicified relative to unaltered rock.

MM 4/9/98

Sample PR002 comprises 12 samples of rock similar to PR001 and from nearby locations, in four pieces, each of the two samples comprises both sides of narrow fractures.

Sample PR003 from the same area above the vitrophyre is similar tuff with preserved fractures.

The prow contact site (#2 on map, page 24) is sampled for fractures. Tuff is light purple and capping out at summit of prow.

Sample PR004 is two rocks containing intact fractures. taken about 1.5 m above the contact between the sill and the Paintbrush tuff. Correct that, it's about 1.5 m from an unmapped dike that runs N-S and cuts through the crest of the prow. The dike-sill contact is about 15 m further down the north

WEY 4/9/98

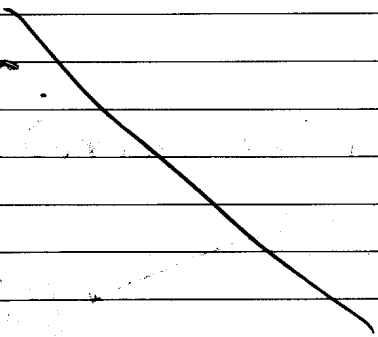
end of the prow.

Sample PR005 is silicified contact metamorphosed tuff taken next to the dike on the north side of the prow.

Near the confluence of several minor tributaries in the central depression of the sill arc is an outcrop on the east slope, called confluence outcrop on map (page 24).

Sample PR006 is mottled white and light purple tuff transected with a reddish fracture zone. Taken at the confluence outcrop.

Sample PR007 has an up to cm wide silica filled fracture, similar mottled silica rich white-purple tuff.



WEY 4/9/98

Information potentially subject to copyright protection was redacted from page 24 of this scientific notebook. The redacted material (map) is from the following reference:

Matyskiela, W. “Silica Redistribution and Hydrologic Changes in Heated Fractured Tuff.” Geology. Vol. 25, No. 12. pp. 1,115–1,118. Bounder, Colorado: Geological Society of America. 1997

Peter C. LaFemina is PCL 7/7/98

Rock samples collected from Paiute Ridge have been sent for thinsectioning. Samples ~~PCL 7/7/98~~ PR001, PR002, PR003, PR004, & PR005 will all have 1 thinsection made. Samples PR006 & PR007 will have thin sections cut across veinlets in the samples, for a total of 2 thin sections per sample.

PCL 7/7/98

September 10, 1998

TO: Jim Spencer (Div. 6)
FROM: Peter La Femina (Div. 20)
RE: XRD Analyses

Jim,

I will need X-ray Diffraction analyses on seven rock samples. The samples will need to be powdered. The sample numbers and weights are as follows:

PR001 - 10.9g
PR002 - 9.0g
PR003 - 9.0g
PR004 - 4.9g
PR005 - 8.3g
PR006 - 6.2g
PR007 - 21.8g

If possible I would like any of the unused powder from each sample. The analysis and sample preparation should be billed to 20-1402-561. Thank you.

Regards,

Peter C. La Femina

Peter C. La Femina

Notes on underground worker training May 11, 1999 at Yucca Mountain Field Operations Center.
Instructor: Joel Karasik

Hard hat
Safety glasses
Steel toe shoes
Ear plugs
Lamp
Self rescuer
Sign in and sign out
} requirements

East west drift - climb up pipes when train passes

Equipment train for large cargo
- sample bottles?

Mine phone: lift toggle to page
press button to talk

GAI phone: talk button on receiver
5 channels

Train signals
back and forth: stop
up and down: forward
circle: back up

5/11/99

Swamper gives signals to train driver.

CO & CO_2 self rescue 30 min - 60 min

Oxygen generator device for workers kept in caches

Refuge chamber at end of TBM in east-west drift.

Super GUT training by Bruce Nakasone

For cross drift 16'5" diameter

LiBr tracer used in cross drift wet cutter head

Railroad ties instead of concrete invert in cross drift

5/11/99

Joel Karasik training on silica

Hazard in sand blasting.

Only effect to lungs. Causes scar tissue at alveoli and bronchiole where oxygen exchange occurs.

Bruce Nakasone on radon.

< 370 Bq/m³ - no danger

> 3700 Bq/m³ - respirator required

5/11/99

5/12/99

Standard First Aid taught by Karasik and Nakasone.

HIV + HBV (hepatitis B) Blood borne pathogens

Check the scene
Call for help
Care for victim

Unconscious: ask if victim is ok
call for help 911
roll to back hands on hips and neck
check for breathing
if none give 2 breaths
check for pulse
if breathing and pulse roll to side to go for help if necessary

CM 5/12/99

Conscious:
Ask questions
Check for injuries
Call for help if necessary

For children explain what you are doing - provide comfort - don't separate child from loved ones.

Check skin color

Ask conscious adult for consent to assist - if answer is no, then don't help.

Unconscious victim yields implied consent.

Rescue Breathing:
2 slow breaths
check pulse
12 breaths in 1 minute
check pulse
...

CM 5/12/99

Blocked airway - unconscious

2 breaths
tilt head again
2 breaths
check pulse
5 abdominal thrusts
clear mouth with finger
2 more breaths
check pulse
5 thrusts
sweep mouth ...

No pulse - no breathing
15 compressions
2 breaths
...
check pulse & breathing every few minutes

5/12/99

Radiation Worker II Training

by Lynn Smith 2 June 1999

NTS ALARA committee reviews potential exposures.

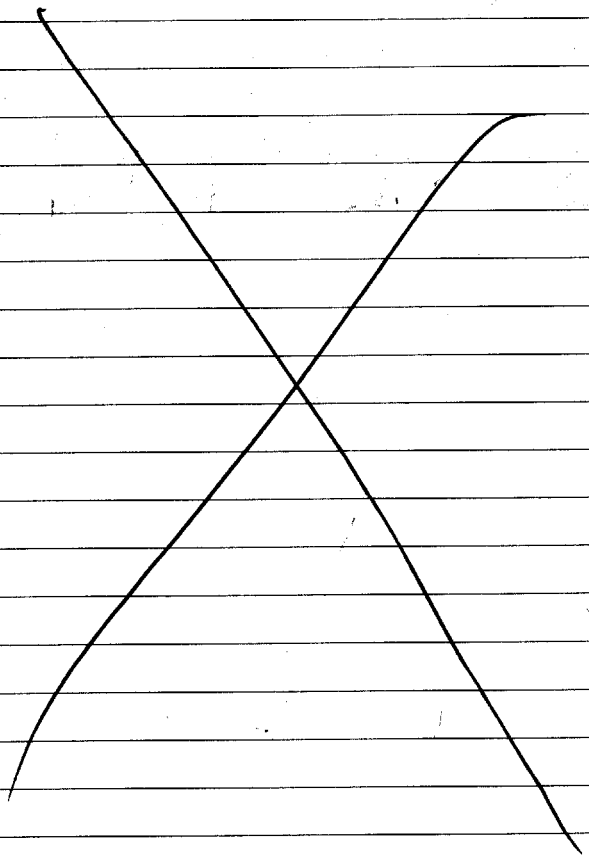
RTC: Radiological Control Technician - Source of information/monitoring

Course successfully completed and card issued to Murphy.

3/June/99

4/June/99 DCL

The preliminary results of x-ray diffraction (XRD) and petrographic analyses of samples collected at Papoose Lake sill / Paiute Ridge, Nevada Test Site, southern Nevada are stapled to the following page.



4/June/99 DCL

Papoose Lake Sill Revisited: A preliminary interpretation of samples collected at Paiute Ridge, Nevada Test Site, southern Nevada

Peter C. La Femina
Scientist

Introduction

The Papoose Lake Sill, located at Paiute Ridge, Nevada Test Site, southern Nevada, has been proposed by Matyskiela (1997a, 1997b) as an analog site for the effects of repository heating on the near-field environment (i.e., the possible decrease in porosity and permeability at the fracture-matrix interface by way of silica redistribution). Three members of the Center for Nuclear Waste Regulatory Analyses (CNWRA) visited Papoose Lake sill site on April 9, 1998, to conduct geological reconnaissance. At this time, six rock samples were collected from three localities within the bounds of the sill. These samples were collected to represent unaltered tuff, altered tuff, and altered tuff with filled fractures. During the visit, several important observations were made. These were (i) that the site geology is not as straight forward as presented in Matyskiela (1997a); this author basically reproduced Byers and Barnes, (1967) 1:24,000 geologic map, (ii) that the rock outcrops are heavily covered by colluvium, masking the geology, and (iii) that several areas have been mapped incorrectly with regards to dike-sill-host tuff contacts; a critical factor in determining the relationships between the basaltic intrusion and host rock alteration.

Methods

The six rock samples were brought back to the CNWRA for geochemical and petrographic analyses. A representative portion of each sample was analyzed by X-ray diffraction (XRD). The XRD analyses were conducted in Division 18 by Jim Spencer (ext. 5068). The results of these analyses were plotted in three formats; a raw plot of intensity versus two-theta, a raw plot of intensity versus two-theta with a qualitative best fit of minerals to the analyses, and a plot of elements measured using energy dispersive spectroscopy (EDS). In addition to the XRD analyses, a portion of each sample was sent out for thin-sectioning. Thin-sections were prepared by Mineral Optics Laboratory, Inc., Wilder, Vermont. In the case of PR006 and PR007, samples that contain fractures, two thin-sections were made. Petrographic analyses were conducted in the Division 20 petrography lab located in building 57, by the author, using a Nikon petrographic microscope. Currently, scanning electron microscopy (SEM) images and EDS analyses are being collected on thin-section PR006. This thin-section of sample PR006 has a through going fracture.

Results (preliminary)

In the following section, mineral names that are in italics were seen petrographically and in the qualitative XRD analyses.

PR001

This is a sample of the non-welded Paintbrush tuff and was collected approximately 3 m west of the

vitrophyre, inside of the Papoose Lake sill on the south-facing slope of Paiute Ridge. The EDS analysis demonstrates the existence of Si, Al, Na, Mg, C, O, K, Ca, Ti, and Fe. The best mineral fits for the analysis show *cristobalite*, albite (disordered), albite (ordered), sodian anorthite (disordered), sodian anorthite (ordered), maghemite, *sanidine* (disordered), orthoclase and *quartz*.

Petrographic Analysis

Rhyolitic tuff. Hypo-crystalline with angular phenocrysts of hornblende, feldspar, *quartz*, muscovite, biotite, *cristobalite*, sanidine , anorthoclase and microcline, and lithic fragments of pumice.

PR002

This sample was collected in the same locality as PR001 and comprises both sides of narrow fractures. The EDS analysis demonstrates the existence of the same elements as PR001 minus C. Ca shows a smaller peak in this sample than in PR001. The mineral constituents are the same as PR001 , with the exception of sanidine being absent in this sample. In sample PR001 sanidine was considered a major constituent and orthoclase a minor one. But in PR002, orthoclase becomes a major constituent and the qualitative analysis drops sanidine. This observation is interesting because I believe I saw sanidine in the thin section.

Petrographic Analysis

Rhyolitic tuff. Hypo-crystalline with angular phenocrysts of hornblende, feldspar, *quartz*, muscovite, biotite, *cristobalite*, sanidine , anorthoclase and microcline, and lithic fragments of pumice.

PR003

This sample was collected in the same locality as PR001 and PR002 and contains intact fractures. This sample contains the same elements as PR002. The qualitative analysis for this sample shows the existence of the same minerals as PR002 with the exception of maghemite. In addition, the qualitative analysis shows the existence of anorthoclase (disordered) and clinoptilolite.

Petrographic Analysis

Rhyolitic tuff. Hypo-crystalline with angular phenocrysts of hornblende, feldspar, *quartz*, muscovite, biotite, *cristobalite*, sanidine , anorthoclase and microcline, and lithic fragments of pumice.

PR004

This sample was collected on the prow of Paiute Ridge approximately 1.5 m from an unmapped N-S trending dike and approximately 15 m above the sill-Paintbrush tuff contact on the north slope of the ridge. This sample contains intact fractures. The EDS analysis demonstrates the existence of O, Na, Mg, Al, Si, S, K, Ca, Ti, and Fe. The qualitative analysis demonstrates the presence of the minerals **cristobalite**, albite (disordered), orthoclase, sodian anorthite (ordered), calcian albite (ordered), and *quartz*.

Petrographic Analysis

Altered, rhyolitic tuff. Hypo-crystalline with angular phenocrysts of hornblende, biotite, muscovite, feldspar, *cristobalite*, and *quartz*.

PR005

This sample is a silicified altered tuff collected from the contact of the N-S trending dike and the tuff. The EDS analysis of this sample demonstrates the presence of O, Na, Mg, Al, Si, K, Ca, and Fe. The qualitative analysis demonstrates the existence of *cristobalite*, *quartz*, sodian anorthite (ordered), anorthoclase (disordered), anorthite (ordered), albite (disordered), orthoclase, and potassian sanidine (disordered).

Petrographic Analysis

Altered, rhyolitic tuff with fracture cross cutting thin section. Fracture is filled with clays? Phenocrysts of biotite, calcite, feldspar, *cristobalite*, *quartz*, and glass. Possible spherulites exist, which would have formed during deuteric alteration.

PR006

This sample was collected from locality three and is an altered, vitric, non-welded Paintbrush tuff. The sample was a mottled white and light purple tuff with a reddish fracture zone. The EDS analysis for this sample is similar to that of PR005, with exception of the presence of Mn. The qualitative analysis demonstrates the existence of cristobalite, sanidine, orthoclase, sodian anorthite (ordered), albite (disordered), potassian sanidine (disordered), anorthite (ordered), and albite (ordered).

Petrographic Analysis

Two thin sections were cut from this sample of rhyolitic tuff. PR006 was cut perpendicular to a fracture. The fracture is well defined along one edge and is filled with phenocrysts of feldspar and quartz. The matrix contains phenocrysts of feldspar, quartz, biotite and hornblende.

PR006 TS-1 is similar to PR006 but contains larger phenocrysts of hornblende. Along the edge of the fracture there is a zone of alteration/mineralization of a Fe mineral. It is possible that this is maghemite.

PR007

This sample was collected in the same locality as PR006 and has a filled fracture with a maximum aperture of 1 cm. The EDS analysis for this sample demonstrates the same elements as present in PR006 with the addition of Ti. The qualitative analysis demonstrates the existence of cristobalite, sodian anorthite (ordered), orthoclase, *sanidine* (disordered), albite (ordered), *quartz*, and gismondine.

Petrographic Analysis

Two thin sections were cut from this sample of rhyolitic tuff. PR007 was cut perpendicular to a fracture. The fracture is filled with smaller phenocrysts than the matrix. Phenocrysts include *quartz*, anorthoclase, *sanidine*, biotite (possibly stilnomelane?), and hornblende.

PR007 TS-1 contains the same mineral constitutents, but has no fracture.

Discussion/Conclusion/Future Work

It is the opinion of this author that more work is needed to determine the significance of alteration in proximity to the Papoose Lake sill. Samples collected thus far, do not definitively show silica redistribution at the fracture/matrix boundary. The XRD analyses sited above were conducted on representative sample splits of each sample. I believe that it might tell us more, if we have just the fracture-fill and matrix material analyzed separately.

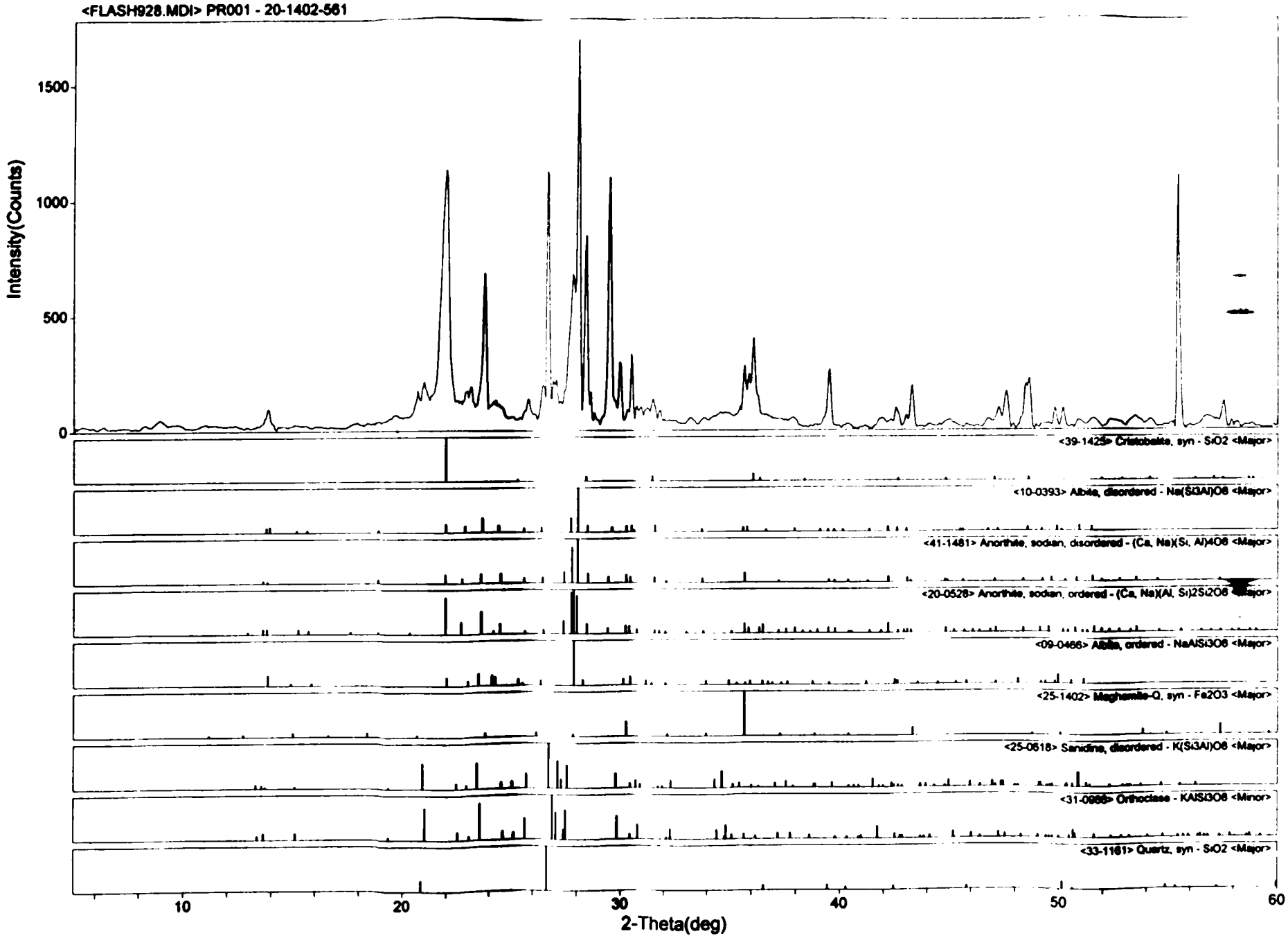
Future fieldwork is needed to collect more samples and to map the local geology in more detail. Samples should be collected along transects, with even sample separation. If time and money exist, samples should also be collected away from other dikes in the field area and samples of the dikes and sills collected for analyses.

References

Byers, F.M., and Barnes, H., 1967. Geologic map of the Paiute Ridge Quadrangle, Nye and Lincoln Counties, Nevada: U.S. Geological Survey Map GQ-577, scale 1:24000, 1 sheet.

Matyskiela, W., 1997a. Silica redistribution and hydrologic changes in heated fractured tuff. Geology, v. 25, no. 12, p. 1115-1118.

Matyskiela, W., 1997b. Papoose Lake Sill: Natural Analogue for a potential repository's hydrothermal effects. Gamma Engineering Corporation, Rockville, Maryland, USA. Gamma Report 97-09.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<20-0528> Anorthite, sodian, ordered - (Ca, Na)(Al, Si)2Si2O8 <Major>
<09-0466> Albite, ordered - NaAlSi3O8 <Major>
<25-1402> Maghemite-Q, syn - Fe2O3 <Major>
<25-0618> Sanidine, disordered - K(Si3Al)O8 <Major>
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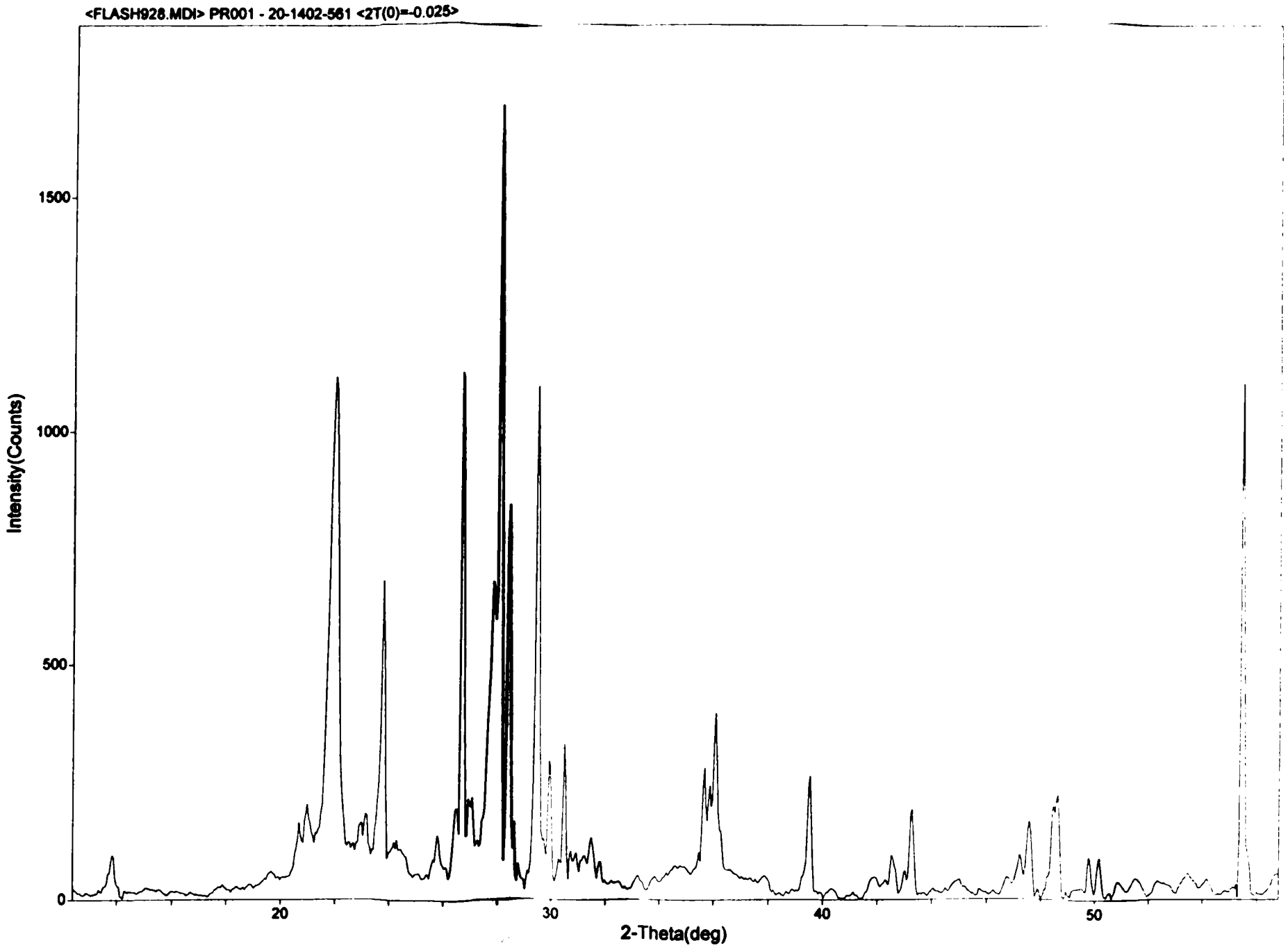
10
20
30
40
50
60
2-Theta(deg)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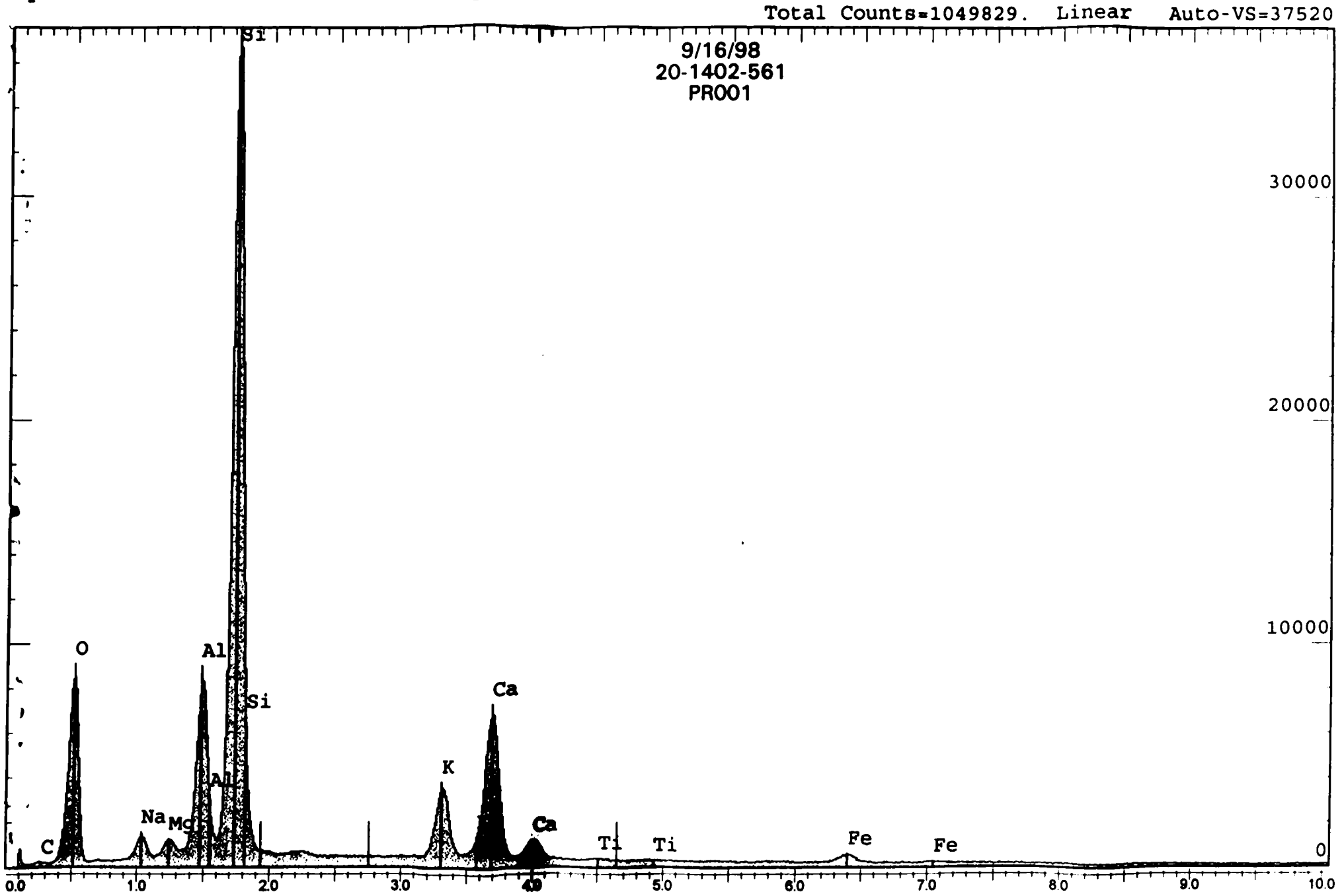
30
40
50
2-Theta(deg)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9/16/98
20-1402-561
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20000
10000
0
O
Al
Si
Ca
K
Na
Mg
Al
Ca
C
Ti
Ti
Fe
Fe
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2.0
3.0
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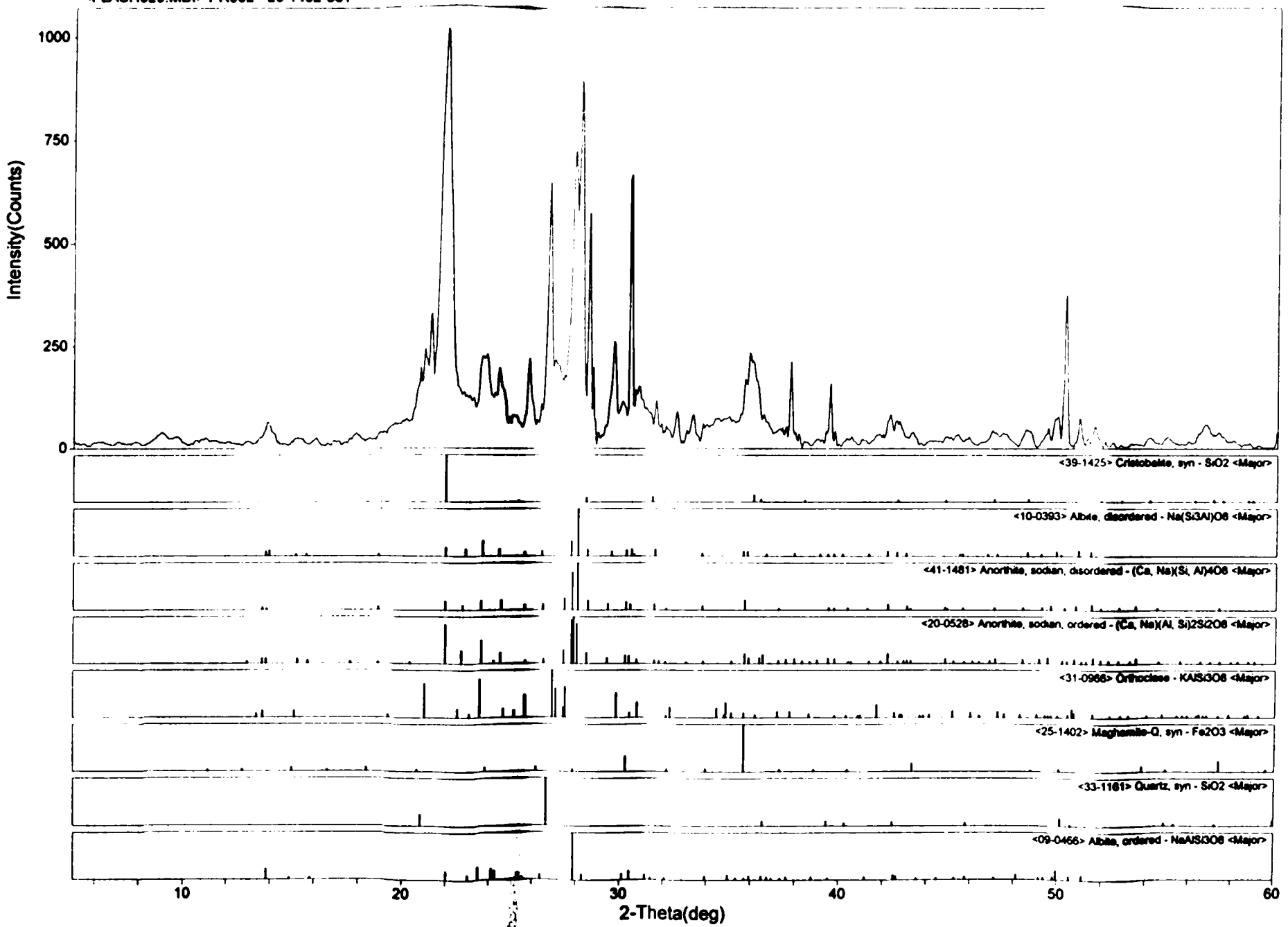
6.0
7.0
8.0
9.0
10.0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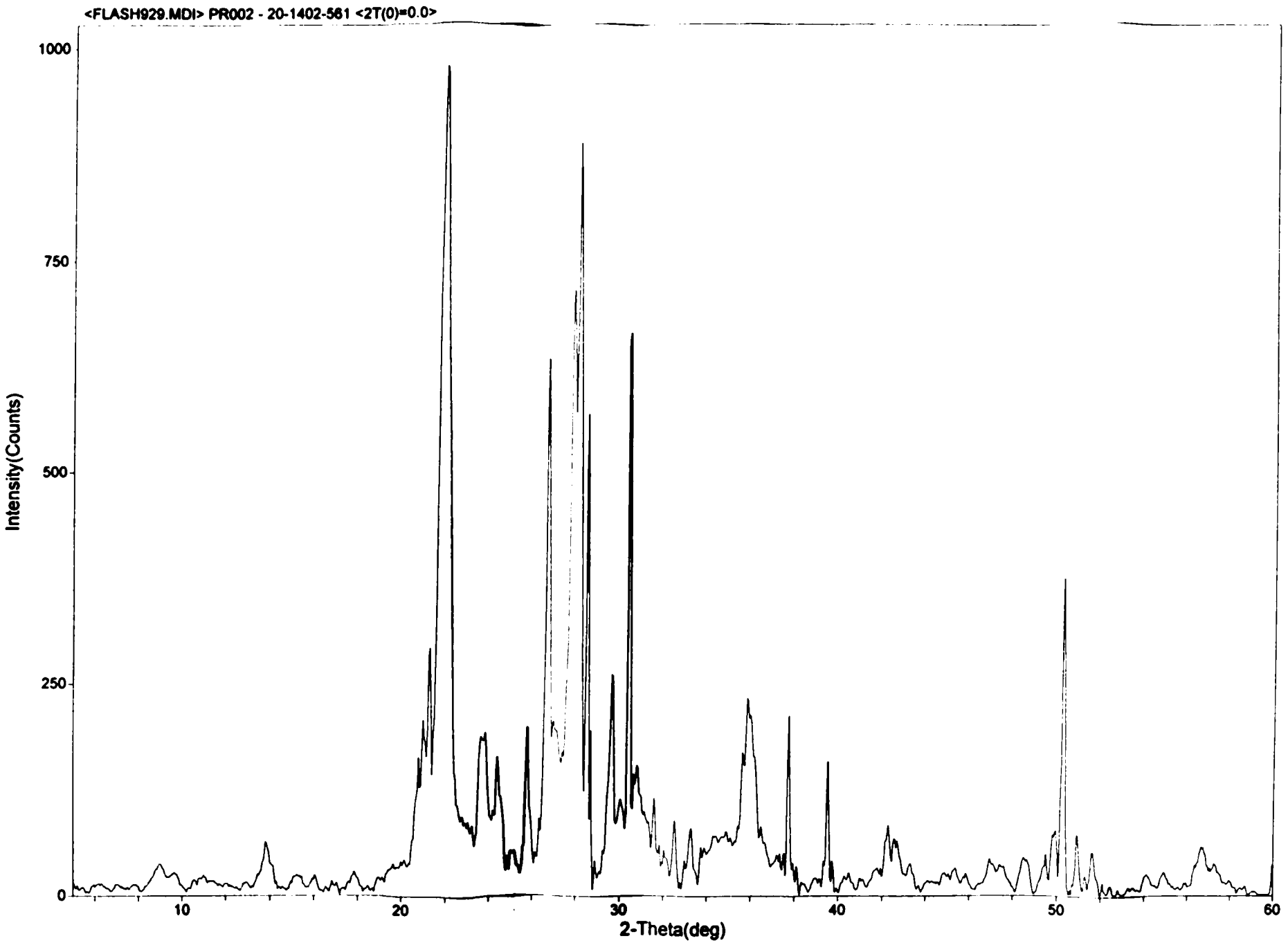
10
20
30
40
50
60
2-Theta(deg)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Intensity(Counts)
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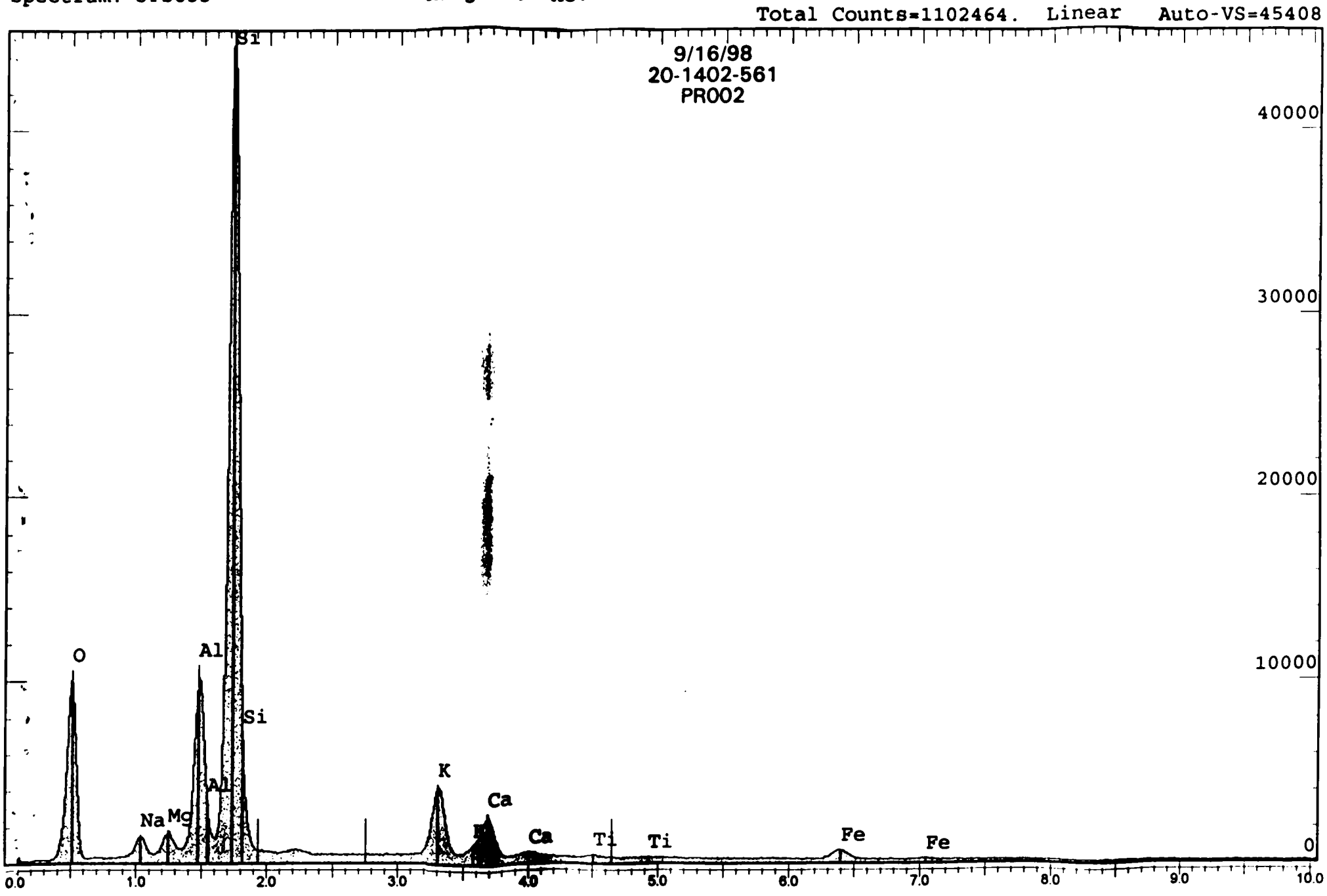
20
30
40
50
60
2-Theta(deg)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9/16/98
20-1402-561
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Si
Na
Mg
Al
K
Ca
Ca
Ti
Ti
Fe
Fe
40000
30000
20000
10000
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2.0
3.0
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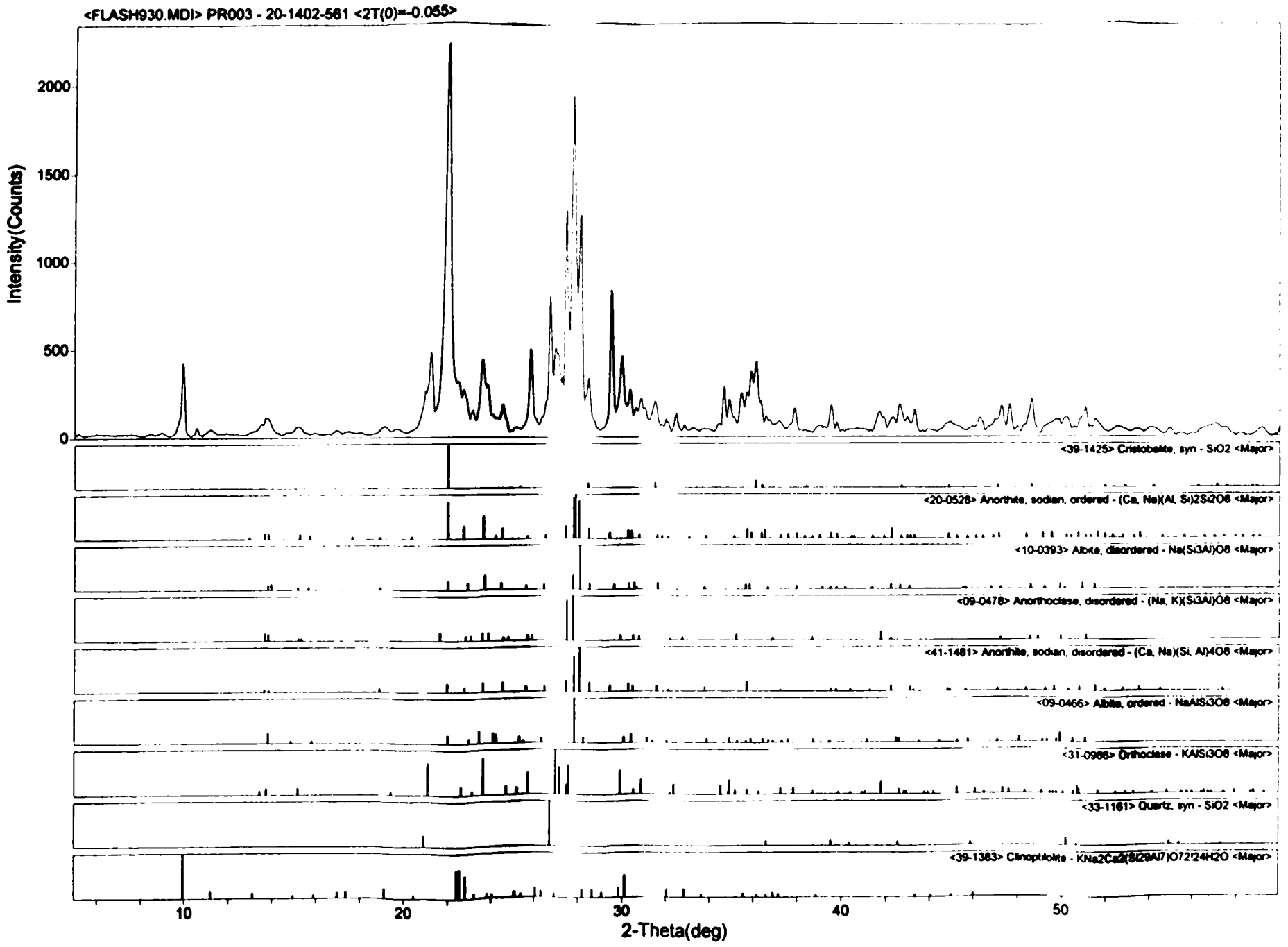
6.0
7.0
8.0
9.0
10.0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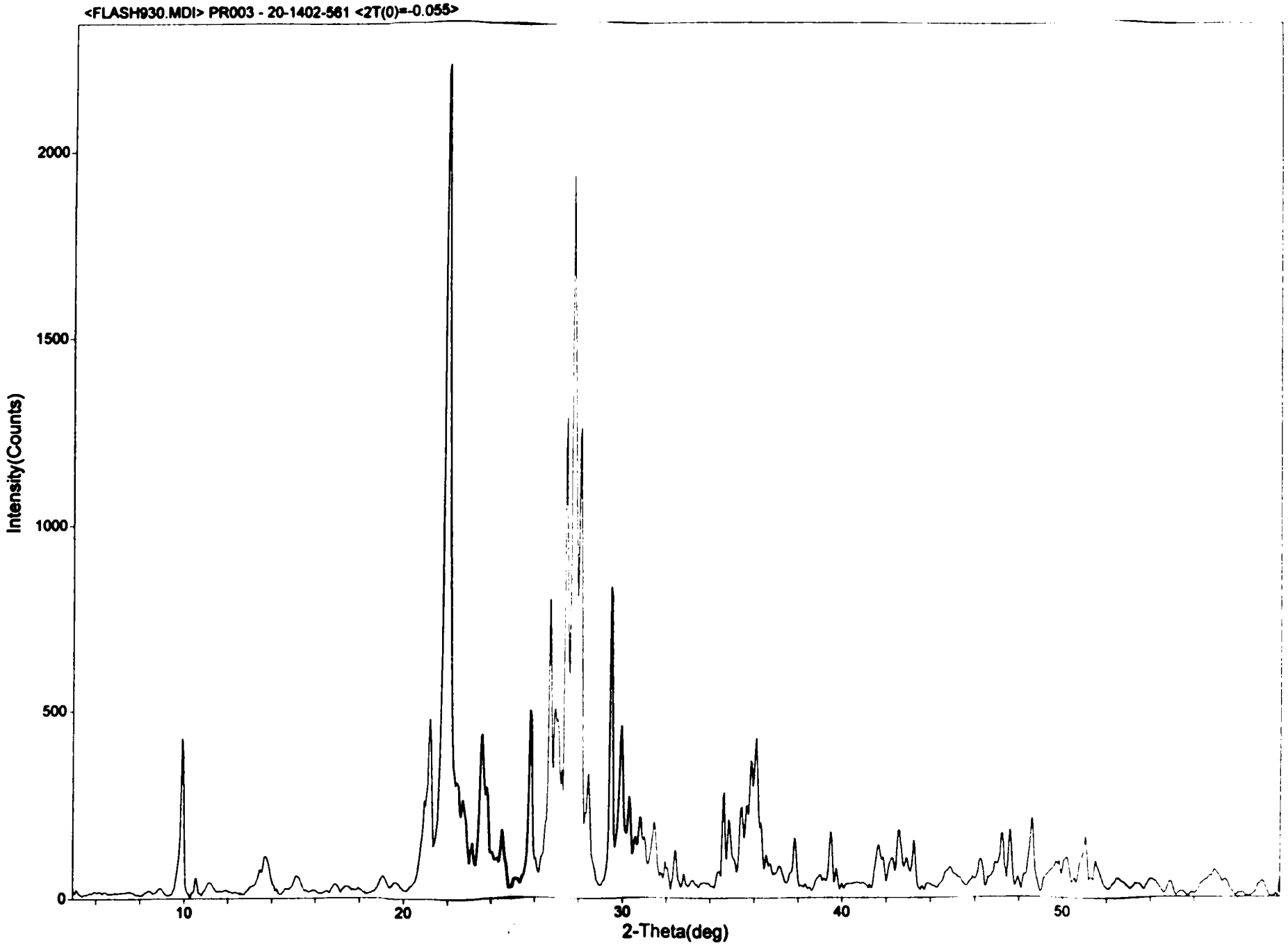
10
20
30
40
50
2-Theta(deg)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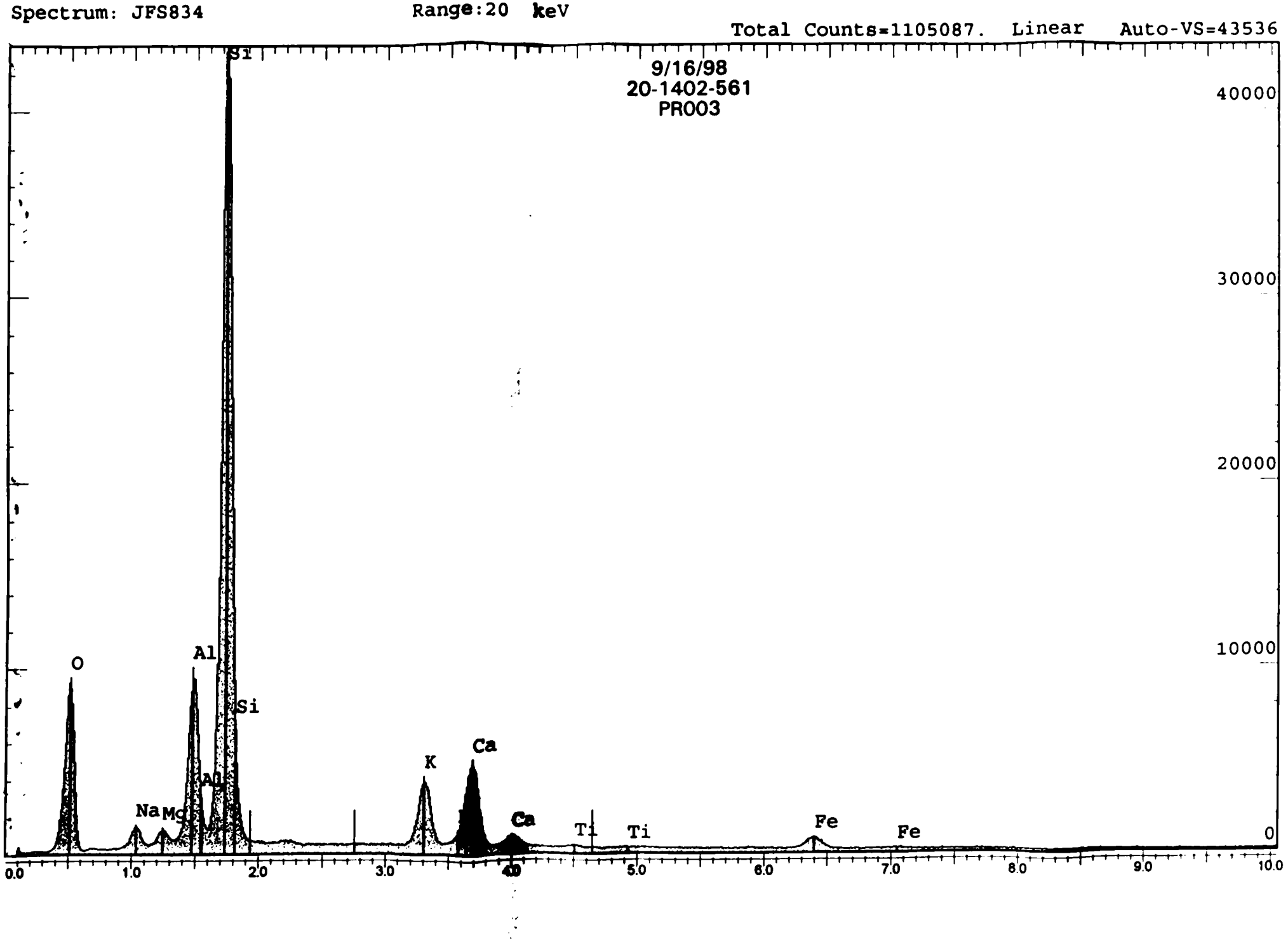
2-Theta(deg)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9/16/98
20-1402-561
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O
Al
Si
Na
Mg
Al
K
Ca
Ca
Ti
Ti
Fe
Fe
40000
30000
20000
10000
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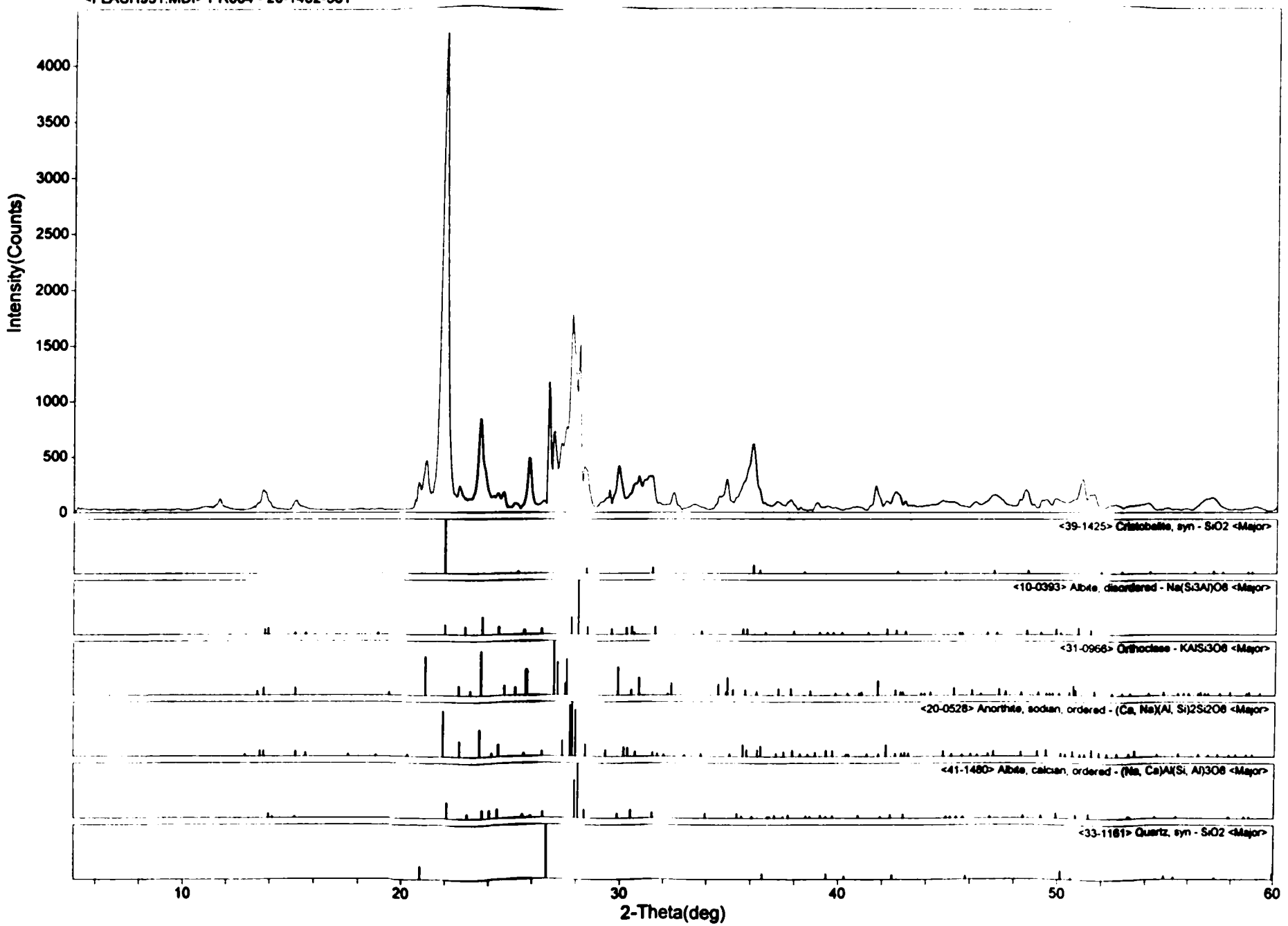
10.0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1000
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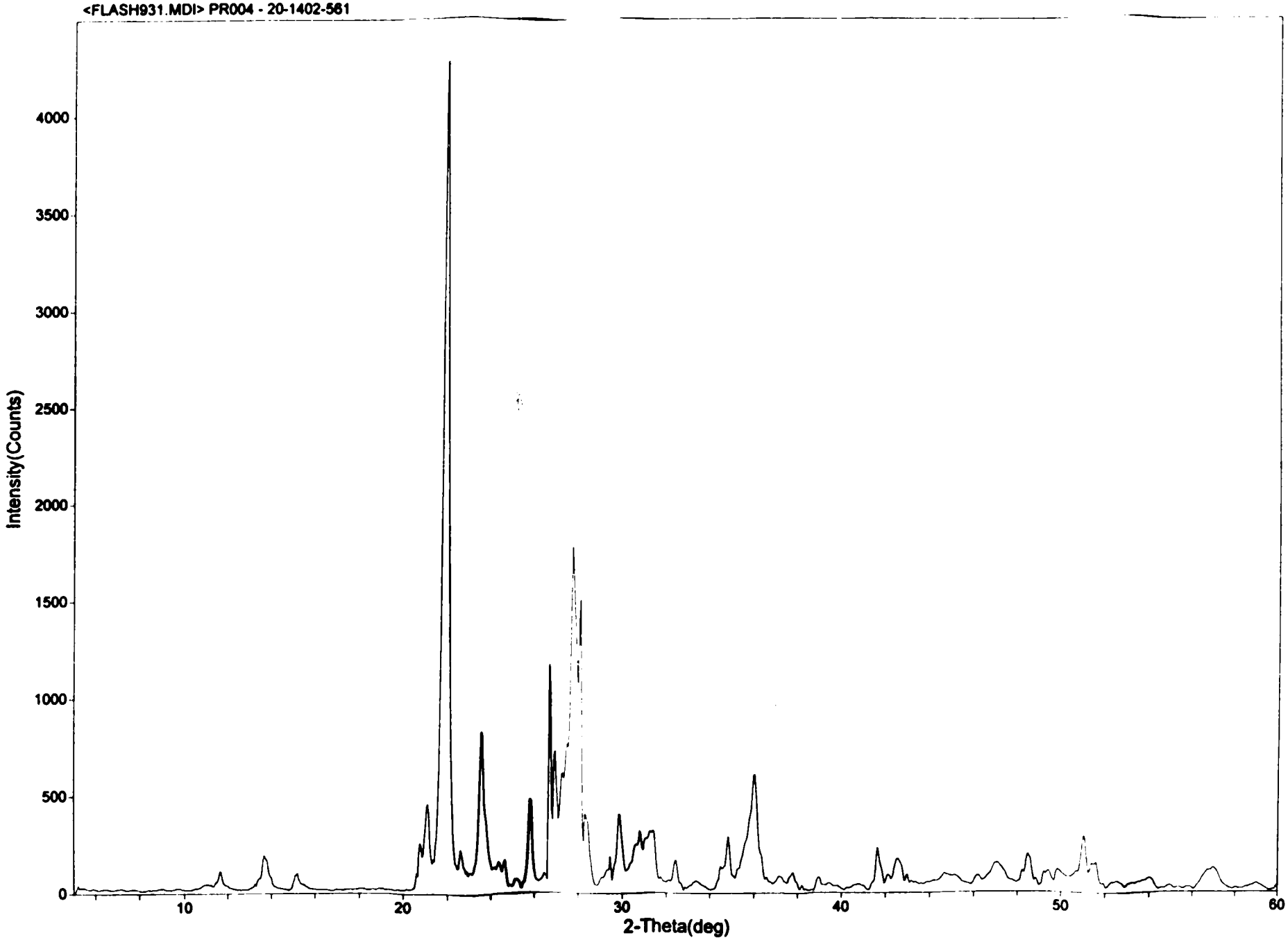
10
20
30
40
50
60
2-Theta(deg)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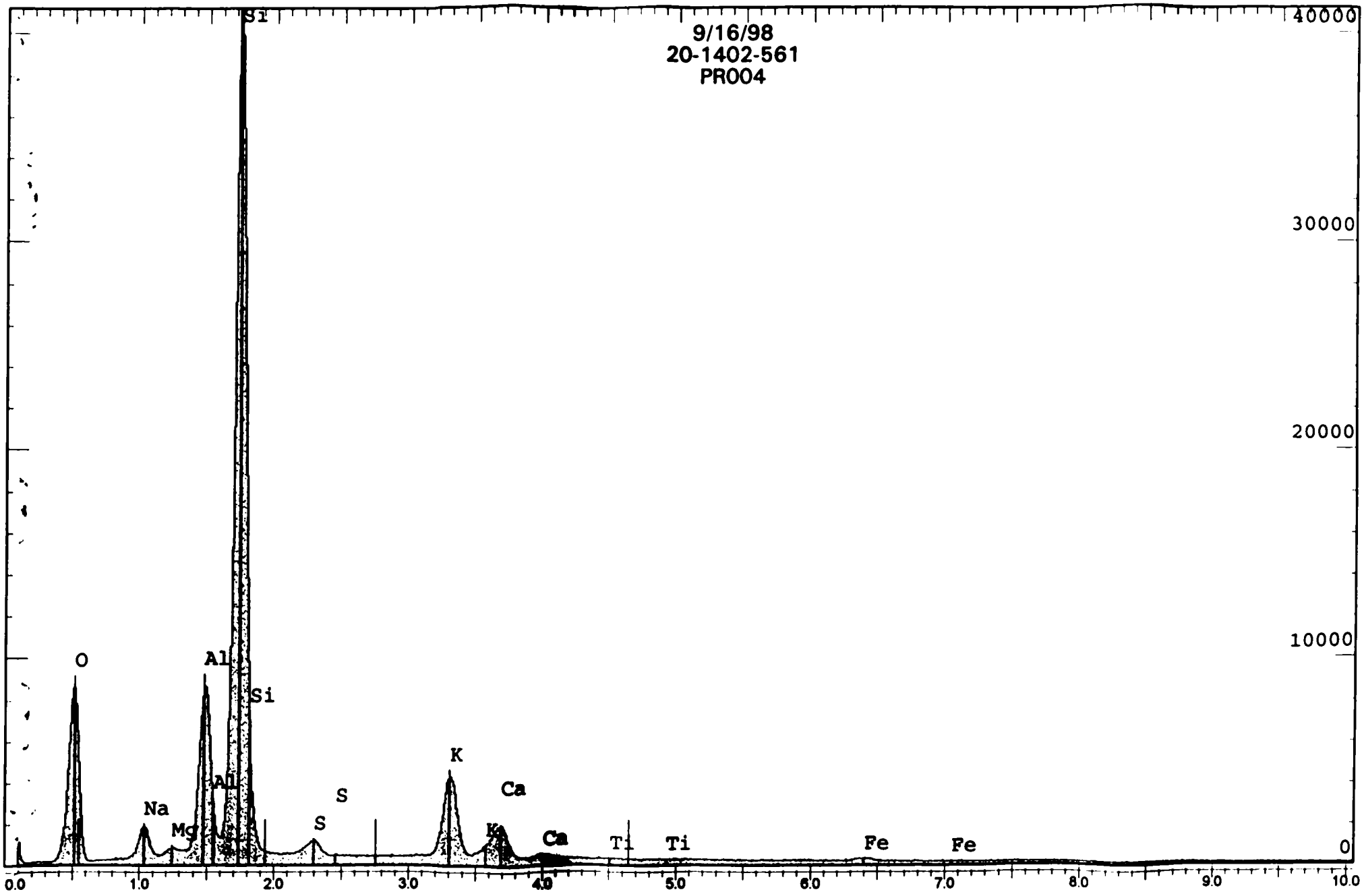
40
50
60
2-Theta(deg)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9/16/98
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30000
20000
10000
0
O
Al
Si
Na
Mg
Al
S
S
K
Ca
Ca
Ti
Ti
Fe
Fe
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6.0
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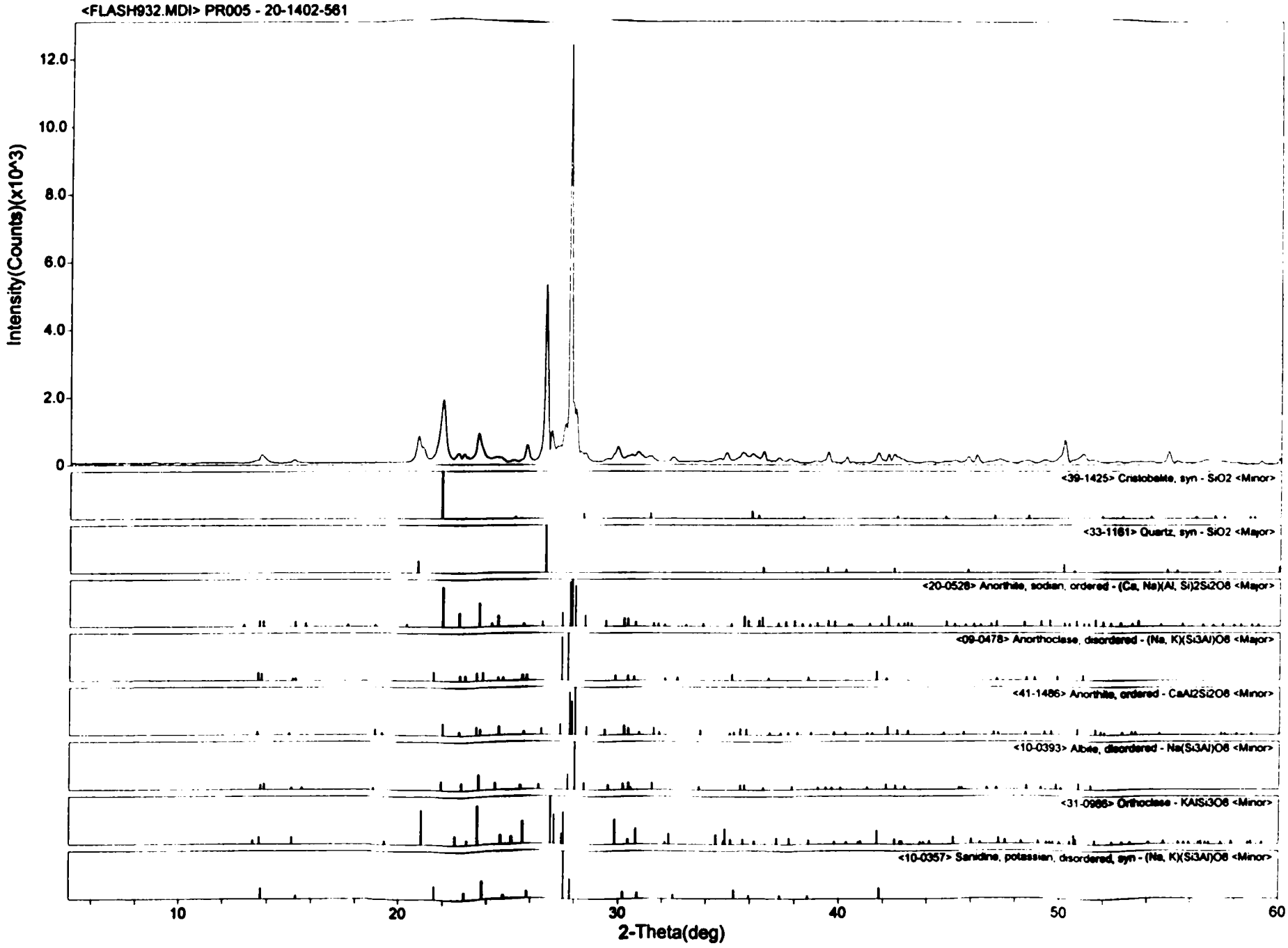
10.0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6.0
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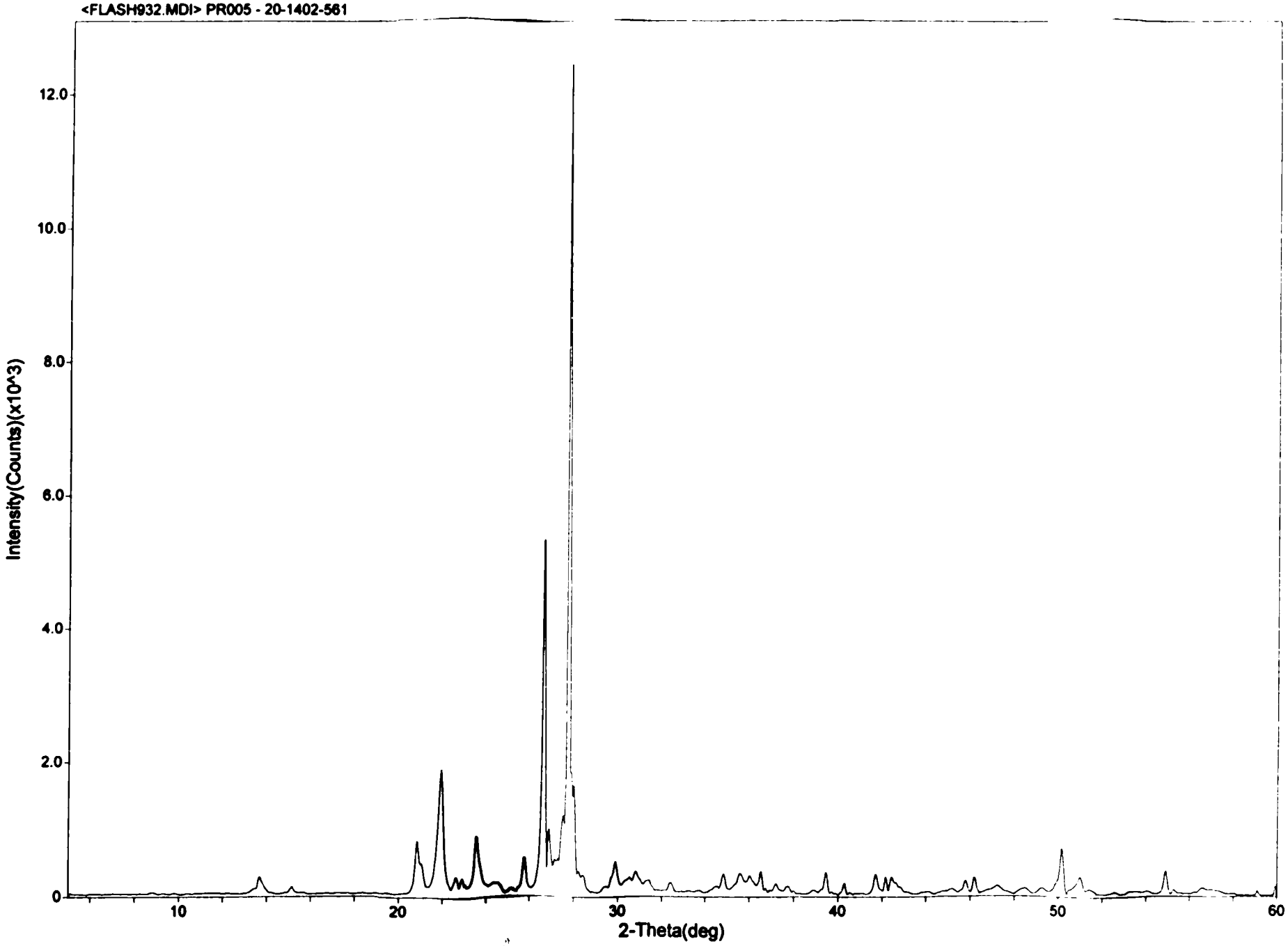
10
20
30
40
50
60
2-Theta(deg)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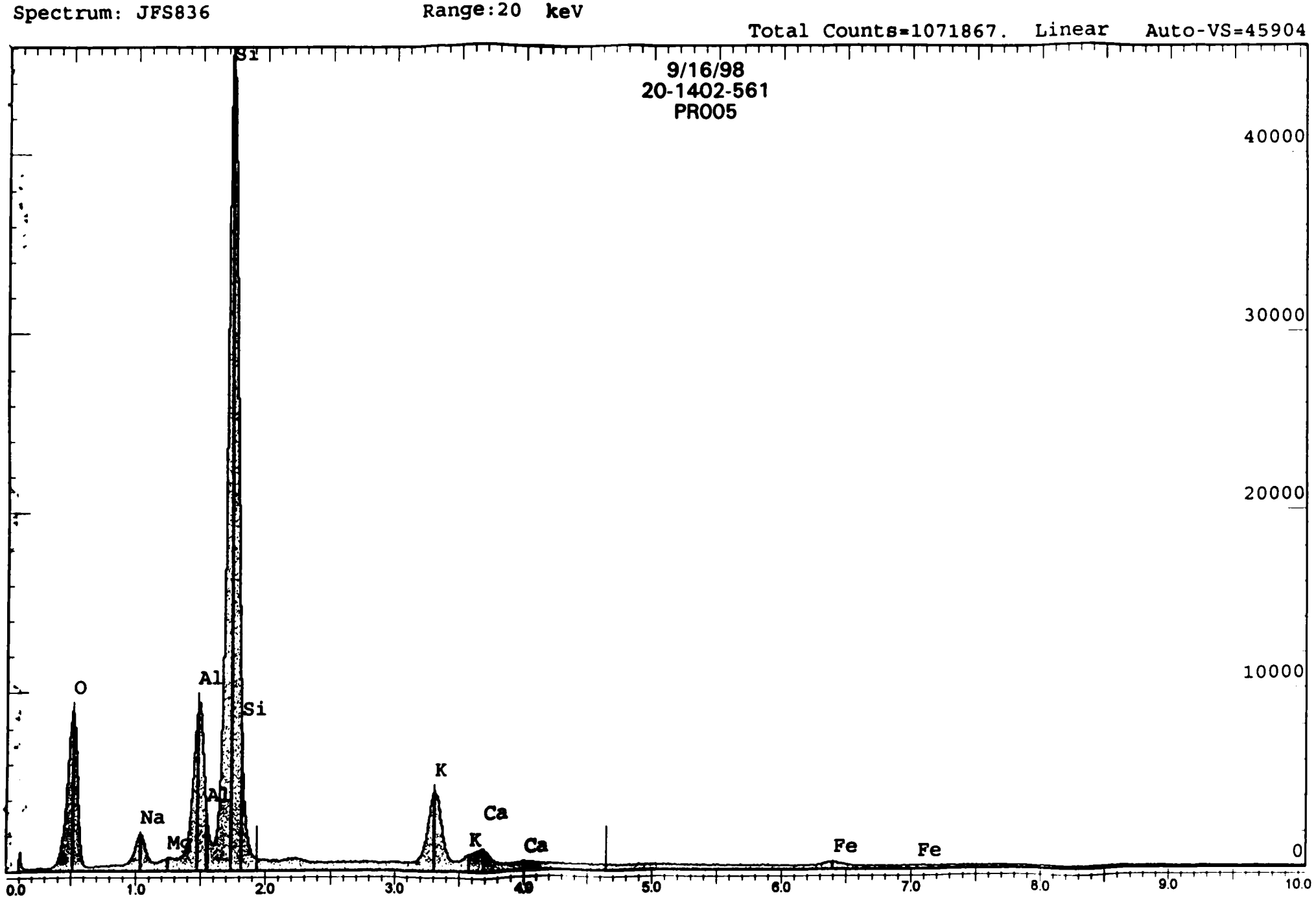
20
30
40
50
60
2-Theta(deg)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9/16/98
20-1402-561
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Si
Na
Mg
Al
K
Ca
K
Ca
Fe
Fe
40000
30000
20000
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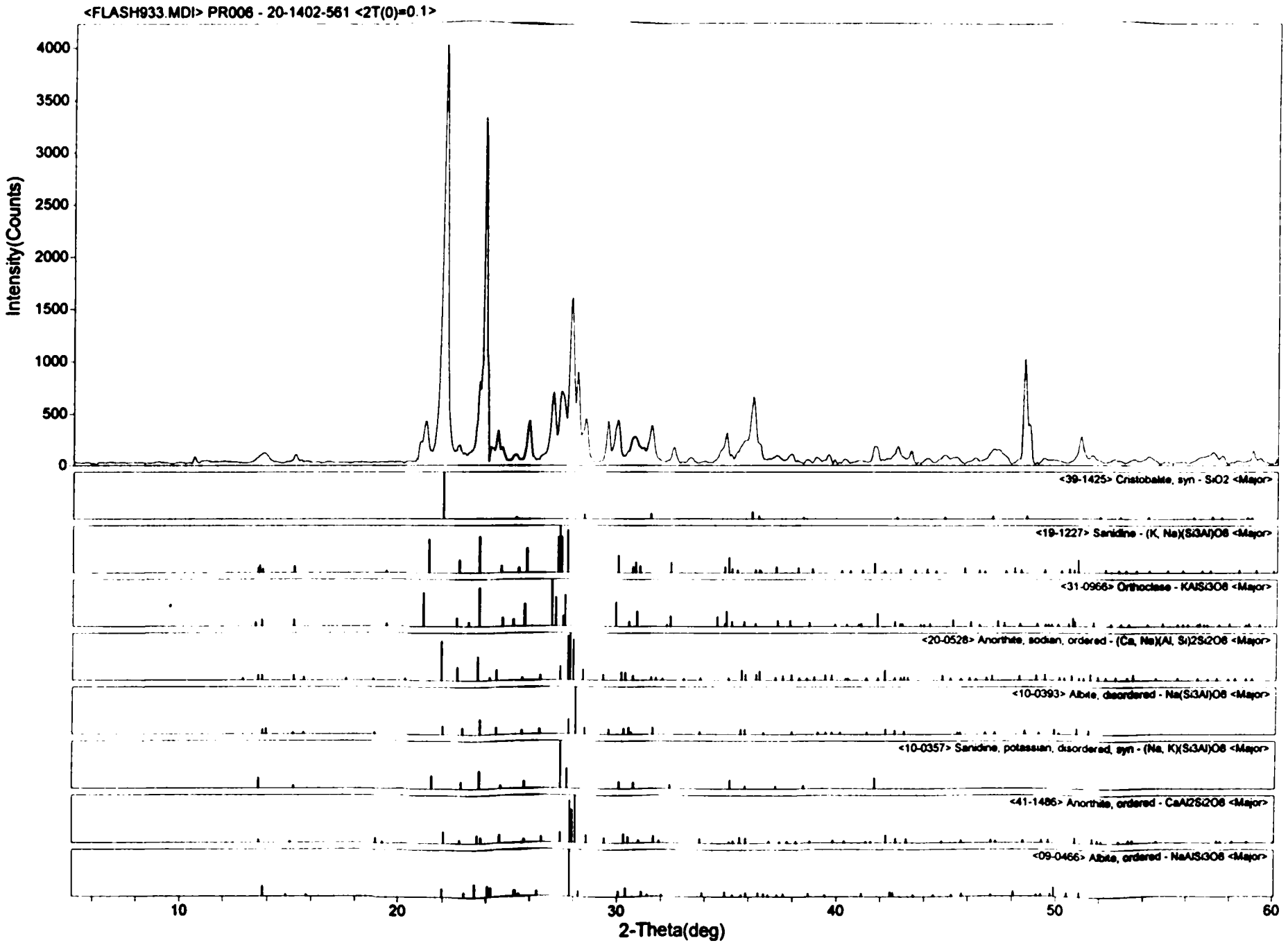
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500
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<10-0393> Albite, disordered - Na(Si3Al)O8 <Major>
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<41-1486> Anorthite, ordered - CaAl2Si2O8 <Major>
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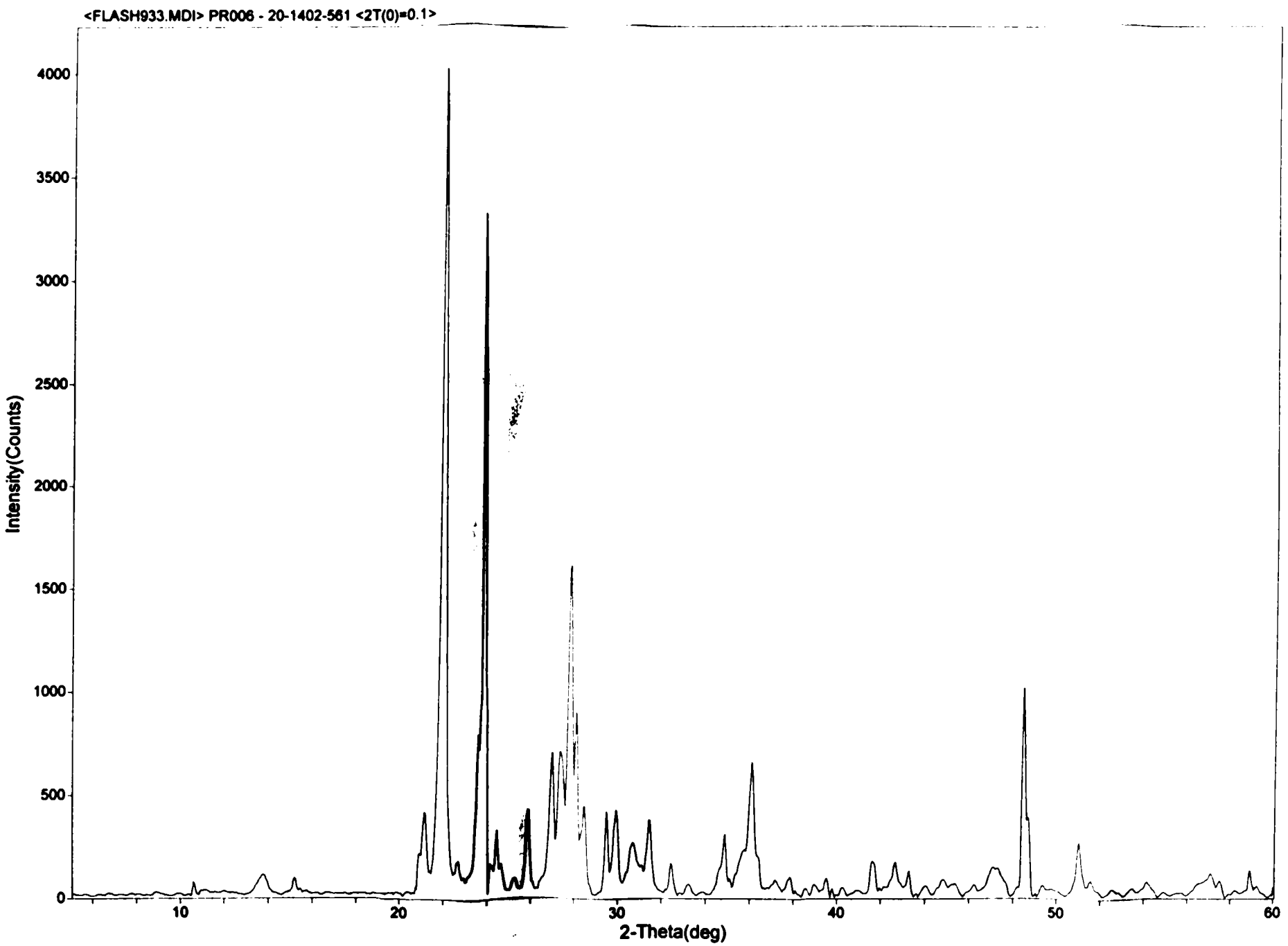
10
20
30
40
50
60
2-Theta(deg)



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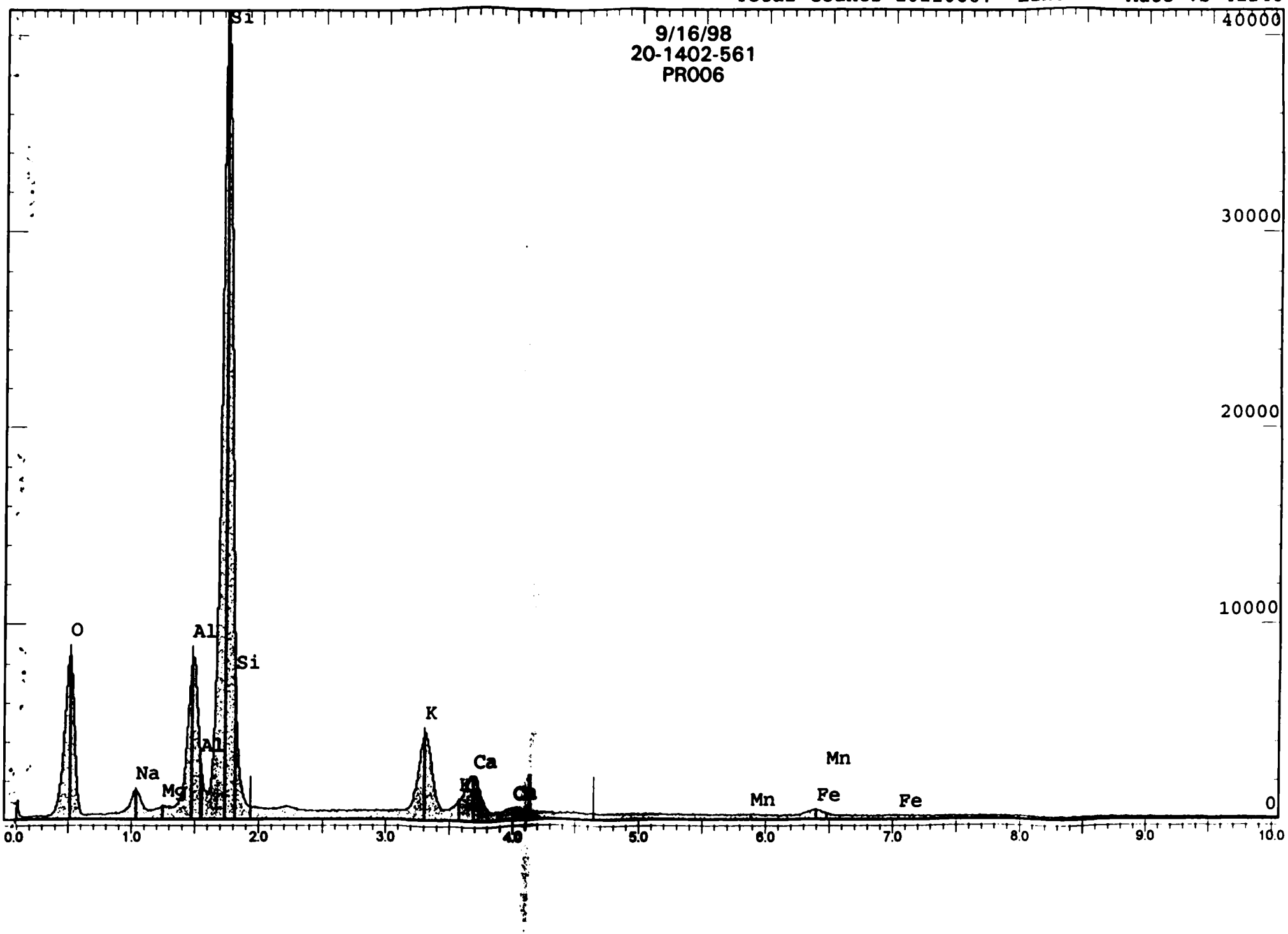
<c \winjade\data> Wednesday, Sep 16, 1998 @ 10:56a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9/16/98
20-1402-561
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20000
10000
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Na
Mg
Al
Si
K
Ca
Mn
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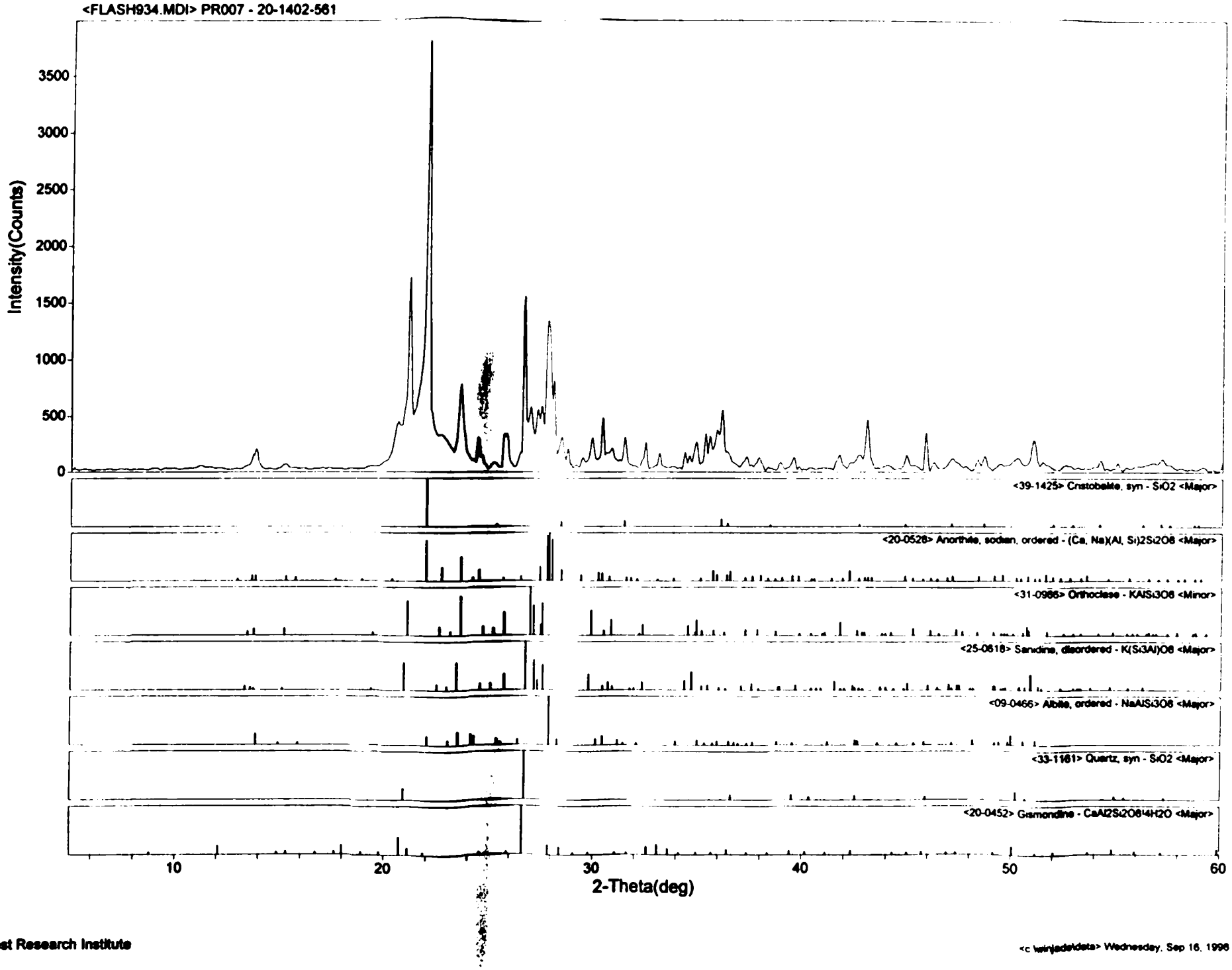
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2000
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500
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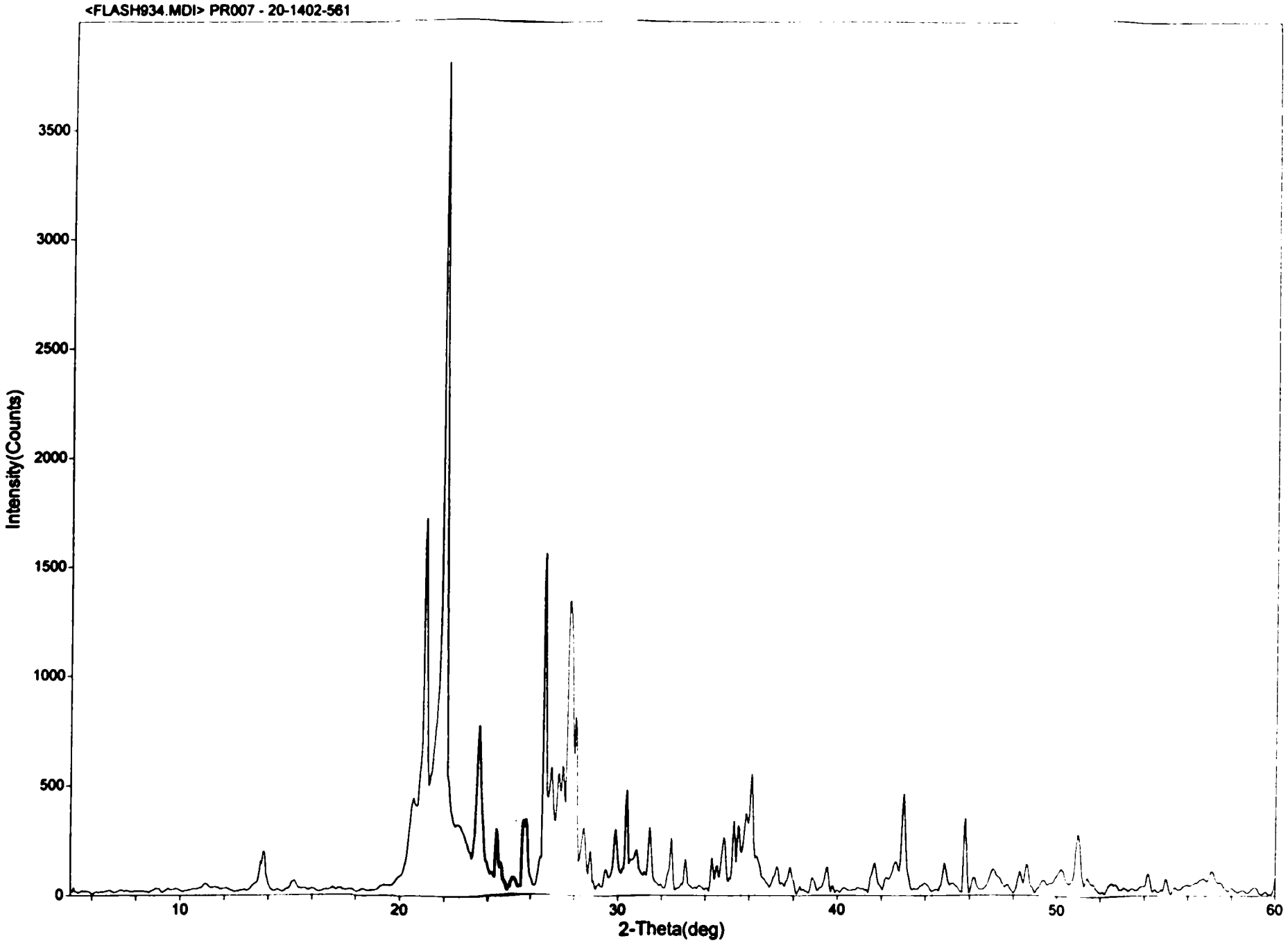
10
20
30
40
50
60
2-Theta(deg)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1500
1000
500
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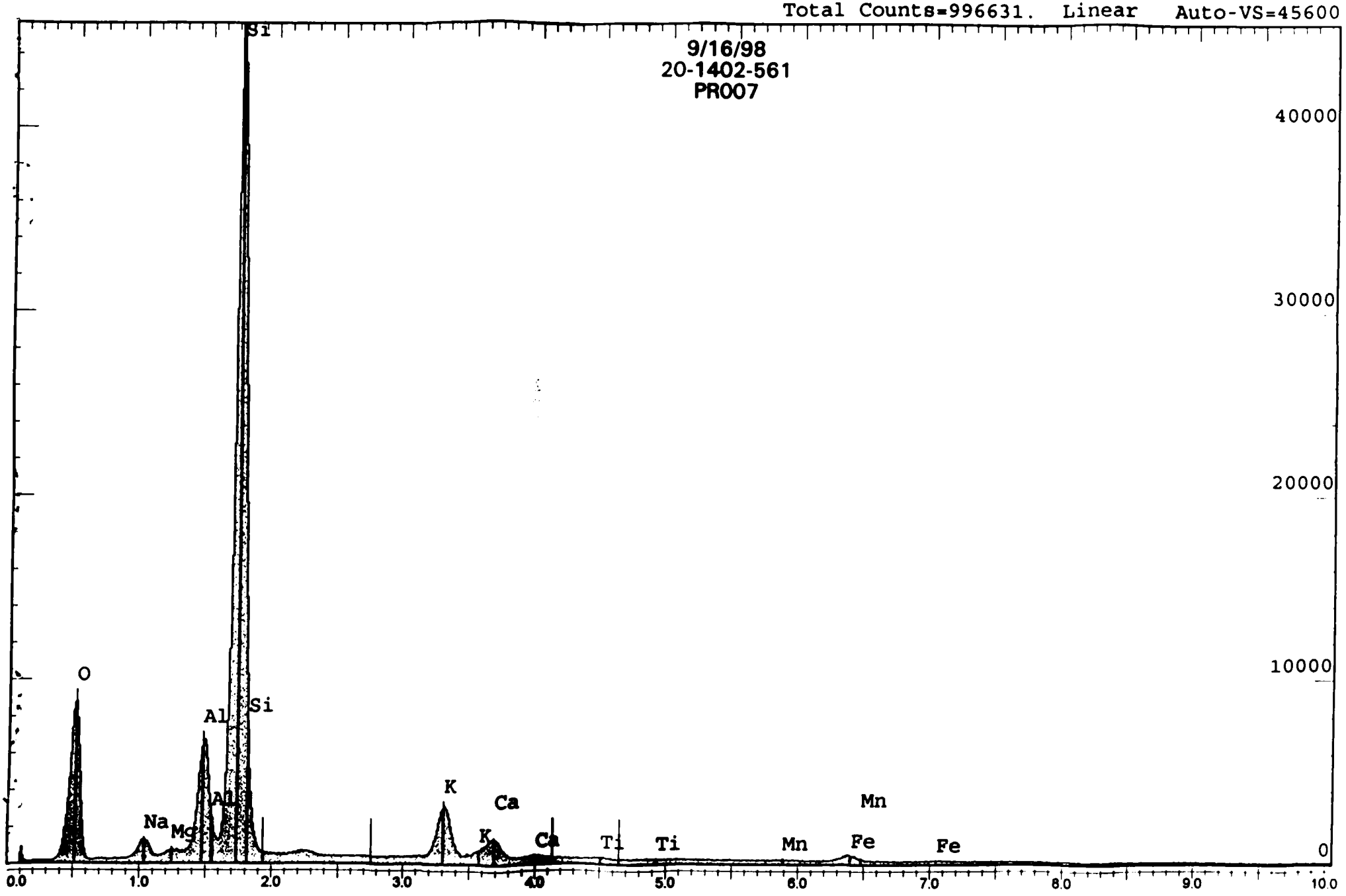
20
30
40
50
60
2-Theta(deg)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9/16/98
20-1402-561
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20000
10000
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O
Na
Mg
Al
Si
Al
K
K
Ca
Ca
Ti
Ti
Mn
Mn
Fe
Fe
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0

This Notebook
Appears to comply
with QAP-001.

E. C. Ley

5/2/2000