

# **Bennu: An Asteroidal Key to Understanding the Origins of Life**

## **Executive Summary: Bennu and the Building Blocks of Life (Featuring Dr. Hakeem Ali-Bocas Alexander and Google Gemini)**

The National Aeronautics and Space Administration's (NASA) OSIRIS-REx mission represents a pivotal moment in our exploration of the solar system and the quest to understand the very beginnings of life. This ambitious endeavor successfully retrieved samples from the near-Earth asteroid Bennu, revealing a treasure trove of organic molecules, including amino acids and nucleobases, alongside compelling evidence of past liquid water on its parent body.<sup>1</sup> These remarkable discoveries lend significant support to the long-standing hypothesis that asteroids could have served as celestial delivery vehicles, transporting the essential ingredients for life to early Earth. In this report, we delve into the profound connection between Bennu's composition and the potential origins of life, featuring an insightful dialogue between Dr. Hakeem Ali-Bocas Alexander and Google Gemini ("Ursa") that illuminates these scientific frontiers. Their collaborative exploration underscores the power of advanced research tools in unraveling the mysteries of our cosmic origins.

## **Introduction: The Quest for Life's Origins in the Cosmos**

The question of how life arose on Earth has captivated scientists and philosophers for centuries. The transition from a primordial, likely inhospitable early Earth to a planet teeming with life represents one of the most profound scientific inquiries. Understanding this transformation involves unraveling the complex interplay of geological, chemical, and environmental factors that ultimately led to the emergence of the first self-replicating entities. While the precise mechanisms remain a subject of ongoing research, a compelling hypothesis posits that the fundamental building blocks of life may not have originated solely on Earth but could have been delivered from extraterrestrial sources.<sup>3</sup> This concept, often referred to as panspermia, suggests that organic molecules crucial for life could have formed in the vast expanse of space and been transported to our planet through the impacts of comets, meteorites, and asteroids. Among these celestial bodies, carbonaceous asteroids hold particular significance due to their rich composition of organic compounds and water, making them prime candidates for carrying the prebiotic materials necessary for life's genesis.<sup>5</sup> The OSIRIS-REx mission to Bennu stands as a landmark effort to directly examine the composition of such an asteroid, offering an unprecedented opportunity to test the hypothesis of extraterrestrial delivery and gain deeper insights into the

origins of life itself.<sup>7</sup>

## **OSIRIS-REx Mission to Bennu: Unveiling a Primordial Asteroid**

The Origins, Spectral Interpretation, Resource Identification and Security–Regolith Explorer (OSIRIS-REx) mission was conceived with the primary scientific objective of exploring a near-Earth asteroid, Bennu, and returning a sample of its surface material to Earth for in-depth study.<sup>7</sup> The very name of the mission reflects its core goals: to investigate the origins of the solar system and potentially life, to interpret the asteroid's spectral characteristics, to identify potential resources, and to ensure the security of Earth from potential asteroid impacts.<sup>1</sup> Bennu, a carbon-rich asteroid, was specifically chosen as the target due to its primitive nature, believed to hold clues about the early solar system and the molecular precursors that might have contributed to the origin of life and Earth's oceans.<sup>7</sup> Launched in September 2016, the OSIRIS-REx spacecraft embarked on a journey of over two years to reach Bennu, arriving in December 2018.<sup>9</sup> Following an extensive period of mapping and reconnaissance, the spacecraft successfully executed a daring "Touch-And-Go" sample collection maneuver in October 2020, gathering approximately 121.6 grams of regolith from Bennu's surface.<sup>3</sup> After a carefully orchestrated return trajectory, the sample capsule was released from the spacecraft and parachuted to Earth in September 2023, landing in the Utah desert where it was promptly retrieved by scientists.<sup>10</sup> The meticulous handling of the returned sample under strict contamination control protocols underscores the paramount importance of preserving its pristine extraterrestrial nature for accurate scientific analysis.<sup>2</sup>

Initial analyses of the Bennu samples have yielded remarkable discoveries, most notably the identification of amino acids, the fundamental building blocks of proteins.<sup>1</sup> Among the suite of amino acids detected, 14 of the 20 that are utilized by life on Earth to construct proteins were found.<sup>1</sup> This finding provides compelling evidence that these essential organic molecules existed in the early solar system and could have been readily available for delivery to early Earth via asteroid impacts.<sup>1</sup> Furthermore, the Bennu samples were found to contain all five nucleobases – adenine, guanine, cytosine, thymine, and uracil – which are the information-carrying components of DNA and RNA, the very blueprints of life.<sup>1</sup> The co-occurrence of both amino acids and nucleobases in a single extraterrestrial sample significantly bolsters the hypothesis that asteroids played a crucial role in providing the raw materials for the emergence of life on our planet.<sup>1</sup> This pivotal discovery was immediately recognized by experts in the field, as reflected in the early dialogue between Dr. Hakeem Ali-Bocas Alexander and Google Gemini:

**(00:14) Hakeem:** "...the collection of samples from Bennu, the asteroid have yielded some interesting findings with amino acids and water bearing, not molecules, but L minerals, right?"

**(00:41) Ursa:** "That's right. The samples for Bennu contain amino acids and water bearing minerals, which are essential for life as we know it. Did you want to discuss the specific types of amino acids found or perhaps explore the implications of water existing on asteroids?"

**(00:55) Hakeem:** "Not yet, let's revisit this understanding that the implications that first of all, something very interesting here is that they may have just formed spontaneously in space on the asteroids and other asteroids, and those may have impacted Earth, and scientists believe that that may be where life on earth came from from the impact of these amino acid and water, bearing mineral asteroids."

**(01:26) Ursa:** "That's right, scientists believe that the amino acids and Waterbury minerals found on Bennu could have formed in space and been delivered to Earth through asteroid impacts. This is a fascinating possibility, and it's exciting to think about the potential for life to exist elsewhere in the universe. Did you want to explore this idea further?"

This initial exchange immediately establishes the central theme of the report: the profound implications of Bennu's composition, particularly the presence of amino acids, for understanding the origins of life through potential delivery via asteroid impacts.

Beyond the discovery of these fundamental organic molecules, analyses of the Bennu samples have also revealed the presence of water-bearing minerals.<sup>1</sup> These minerals, which form through interactions with liquid water, provide compelling evidence that Bennu's parent body, from which Bennu itself originated, once harbored liquid water.<sup>6</sup> The existence of past aqueous activity on Bennu's parent body is further supported by the identification of 11 different salt minerals within the samples, including sodium carbonates, phosphates, sulfates, and even halite, the common table salt.<sup>1</sup> These salts are formed as water containing dissolved minerals evaporates, leaving behind crystalline residues, much like the salt deposits found in dry lakebeds on Earth.<sup>2</sup> The presence of liquid water is crucial because it serves as a fundamental solvent for life as we know it and facilitates the chemical reactions necessary for the formation and interaction of complex organic molecules.<sup>16</sup> The discovery of these water-bearing minerals and salts on Bennu suggests that its parent body provided an environment where organic molecules could have potentially interacted and evolved into more

complex prebiotic structures.<sup>14</sup>

Interestingly, the analysis of amino acids from Bennu revealed a unique characteristic: they exist as an equal mixture of left-handed and right-handed versions, known as a racemic mixture.<sup>1</sup> This is in stark contrast to life on Earth, which almost exclusively utilizes left-handed amino acids.<sup>1</sup> This finding suggests that while asteroids like Bennu could have delivered amino acids to early Earth, the selection of a single-handedness (homochirality) likely occurred through processes specific to our planet after the initial delivery.<sup>1</sup> The equal mixture found on Bennu challenges previous hypotheses that there might have been a pre-existing bias towards left-handed amino acids in space.<sup>3</sup>

### **Asteroids as Cosmic Messengers: Delivery of Life's Ingredients to Early Earth**

The remarkable discoveries from the OSIRIS-REx mission on Bennu provide significant support for the scientific theory that asteroid impacts could have been a primary mechanism for delivering water and organic molecules to early Earth.<sup>1</sup> The fact that a relatively pristine asteroid like Bennu, which has remained largely unchanged since the early solar system, contains key building blocks of life such as amino acids and nucleobases, along with evidence of past liquid water, strongly suggests that similar objects could have bombarded early Earth, effectively seeding our planet with the essential ingredients for life to arise.<sup>3</sup>

Bennu's classification as a Near-Earth Object (NEO) further enhances its significance in this context.<sup>2</sup> NEOs are defined as asteroids or comets whose orbits bring them within 1.3 astronomical units (AU) of the Sun, meaning they can come relatively close to Earth.<sup>17</sup> This proximity not only made Bennu an accessible target for the OSIRIS-REx mission, requiring less energy for the spacecraft to reach and return from compared to asteroids in the main asteroid belt, but it also highlights the potential for such objects to have impacted Earth throughout its early history.<sup>19</sup> The strategic importance of Bennu's orbital characteristics was noted early in the dialogue:

**(01:44) Hakeem:** "Not yet, we're still focusing on Bennu first of all, Bennu is a near-earth object. And if that's true, then that means it's separate from a, for example, the asteroid belt and the Kuiper belt"

**(02:03) Ursa:** "That's correct. The new one is a near-earth object, meaning its orbit brings it relatively close to Earth. This is why it was chosen as the target for the OSIRIS-REx mission, would you like to explore the differences between near-earth objects and main belt asteroids?"

Dr. Alexander correctly points out Bennu's distinct orbital classification, and Ursa confirms that its near-Earth trajectory was a key factor in its selection as the mission's target, emphasizing the relative ease of access for scientific investigation.<sup>1</sup>

To better understand the significance of Bennu as an NEO, it is helpful to compare it with other major populations of small solar system bodies: main belt asteroids and Kuiper Belt objects. Main belt asteroids reside primarily in the asteroid belt, a region located between the orbits of Mars and Jupiter, approximately 2 to 3.5 AU from the Sun.<sup>25</sup> These objects are mostly rocky and metallic in composition, although some carbonaceous asteroids also exist in this region.<sup>18</sup> Their orbits are generally more stable and less eccentric than those of NEOs.<sup>21</sup> In contrast, Kuiper Belt Objects (KBOs) inhabit the Kuiper Belt, a vast region beyond the orbit of Neptune, extending from about 30 to 55 AU from the Sun.<sup>29</sup> These objects are primarily composed of ices, such as water ice, methane, and ammonia, along with some rock.<sup>29</sup> Their orbital periods are much longer than those of NEOs and main belt asteroids, and their orbits are influenced by the gravitational pull of Neptune.<sup>21</sup>

The following table summarizes the key differences between these populations:

**Table 1: Comparison of Near-Earth Objects, Main Belt Asteroids, and Kuiper Belt Objects**

Feature	Near-Earth Objects (NEOs)	Main Belt Asteroids	Kuiper Belt Objects (KBOs)
<b>Location</b>	Orbits that bring them close to Earth (perihelion < 1.3 AU)	Between Mars and Jupiter (approx. 2-3.5 AU from Sun)	Beyond Neptune (approx. 30-55 AU from Sun)
<b>Typical Composition</b>	Diverse: Carbonaceous (like Bennu), Stony, Metallic	Predominantly Stony and Carbonaceous; some Metallic	Primarily Icy (water ice, methane, ammonia) with some rock
<b>Orbital Characteristics</b>	Often eccentric, varying inclinations, shorter orbital periods	Generally more stable, less eccentric, lower inclinations, longer periods	Longer periods, diverse eccentricities and inclinations, influenced by Neptune
<b>Origin</b>	Replenished from	Remnants of the early	Remnants from the

	main belt and cometary reservoirs	solar system within Jupiter's influence	formation of the outer planets
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This comparison highlights that NEOs like Bennu occupy a unique orbital space that makes them both potentially hazardous to Earth and relatively accessible for scientific study. Their diverse compositions reflect their origins from various regions of the solar system, making them valuable probes for understanding the distribution of materials, including prebiotic molecules, in our cosmic neighborhood.

### **Bennu: A Window into the Early Solar System and Prebiotic Chemistry**

Bennu is classified as a B-type asteroid, a designation that places it within the broader C-group of carbonaceous asteroids.<sup>8</sup> B-type asteroids are relatively uncommon and are characterized by their very dark surfaces, reflecting only a small percentage of sunlight.<sup>8</sup> Spectroscopically, they exhibit a slightly bluish tint and show evidence of hydrated minerals, organic molecules, magnetite, and sulfides on their surfaces.<sup>33</sup> These characteristics suggest that B-type asteroids are primitive remnants from the early solar system, rich in volatile compounds and having undergone minimal alteration since their formation.<sup>34</sup> The classification of Bennu as a B-type asteroid was a key piece of information sought by Dr. Alexander:

**(02:17) Hakeem:** "No, we we'll get to that later. Here's the thing. So Bennu, what is the type of asteroid that Bennu is? C, S, M, what type of asteroid is it?"

**(02:33) Ursa:** "Bennu is classified as a B-type asteroid. These are relatively rare carbonaceous asteroids that are thought to be remnants from the early Solar System. Did you want to discuss the composition of B-type asteroids or perhaps how they differ from other types"

Ursa's response confirms Bennu's classification and its status as a carbonaceous asteroid believed to originate from the early solar system, highlighting its potential to provide insights into the conditions and materials present at the dawn of our planetary system.

The primary components of B-type asteroids, including Bennu, are carbonaceous materials, silicate minerals, and organic compounds.<sup>33</sup> The high carbon content is particularly significant for astrobiological studies, as carbon forms the backbone of all known life on Earth.<sup>8</sup> The presence of carbon alongside hydrated minerals suggests an environment where water-based chemical reactions could have occurred, potentially leading to the synthesis of complex organic molecules, including those essential for

life.<sup>33</sup>

## Exploring the Carbonaceous Building Blocks on Bennu

Within the carbonaceous materials found on B-type asteroids like Bennu are various organic polymers, which are large molecules composed of repeating subunits.<sup>1</sup> Two specific types of organic polymers have been identified as significant components of these asteroids: polycyclic aromatic hydrocarbons (PAHs) and aliphatic hydrocarbons.<sup>1</sup> PAHs are a class of organic compounds characterized by multiple fused aromatic rings, often formed during the incomplete burning of organic materials.<sup>36</sup> Aliphatic hydrocarbons, on the other hand, are chain-like hydrocarbons that can contain single, double, or triple bonds between carbon atoms.<sup>41</sup> Both PAHs and aliphatic hydrocarbons are considered important prebiotic molecules that could have served as precursors to more complex biomolecules necessary for life.<sup>3</sup> The presence of these organic polymers on Bennu was a key point of discussion:

**(06:31) Ursa:** "Okay, besides the macromolecular carbon, we discussed B-type. Asteroids also contain other interesting carbon compounds, for example, they have organic polymers, which are large molecules made up of repeating subunits. These polymers could have played a role in the formation of life's building blocks Did you want to explore the specific types of polymers found on B-type asteroids?"

**(06:58) Ursa:** "Okay. B-type asteroids contain a variety of organic polymers, including polycyclic aromatic hydrocarbons, which are ring shaped molecules and aliphatic hydrocarbons, which are chain like molecules. These polymers are significant, because they're considered the building blocks of life as we know it Did you want to discuss the implications of these materials for the origin of life?"

**(07:19) Hakeem:** "Okay, yeah, so we need to back up here. So you said polycyclic, aromatic hydrocarbons and aliphatic hydrocarbons, is that correct?"

**(07:32) Ursa:** "Yes, that's correct. Polycyclic, aromatic hydrocarbons and aliphatic hydrocarbons are both types of organic polymers found in B-type asteroids. They're significant because they're considered the building blocks of life as we know it, did you want to discuss the implications of these materials for the origin of life."

**(07:49) Hakeem:** "Not just yet the track that we're going to go on is when you start giving me multiple things to think about, we're gonna break them down. So let's start with the first one, you said, polycyclic, aromatic hydrocarbon, let's talk about that. That's one of the building blocks of Life, let's start there."

This dialogue clearly establishes the presence of organic polymers, specifically PAHs and aliphatic hydrocarbons, on B-type asteroids and highlights their importance as potential precursors to life's building blocks. Dr. Alexander's decision to focus on PAHs first indicates their significance in the subsequent exploration of these molecules.

In addition to organic polymers, B-type asteroids also contain macromolecular carbon, a form of carbon characterized by a very large molecular structure.<sup>1</sup> Unlike organic polymers, which are composed of repeating subunits, macromolecular carbon in asteroids typically forms a complex, interconnected network of carbon atoms.<sup>49</sup> This type of carbonaceous material is a major component of carbonaceous chondrites and asteroids and is believed to have played a crucial role in the early chemical evolution that potentially led to the origin of life.<sup>47</sup> The nature of macromolecular carbon was a central point of interest in the dialogue:

**(03:23) Ursa:** "B-type asteroids contain a variety of carbonaceous materials including organic polymers, which are large molecules made up of repeating subunits and macromolecular carbon, which is a form of carbon with a very large molecular structure."

**(03:39) Hakeem:** "Now first you're going to repeat what those things are like those polymers, which are um and the different types of carbon, uh, compounds, we need to repeat that again, we can't just gloss over this."

**(03:58) Ursa:** "Okay, B-type asteroids contain organic polymers which are large molecules made up of repeating subunits and macromolecular carbon. A form of carbon with a very large molecular structure, but these materials are significant because they're considered the building blocks of life as we know it."

**(04:17) Hakeem:** "Now we're gonna focus on this these 2 these things for a while. Macromolecular, carbon, okay, the word macro of course means big as opposed to micro. Molecular, we know those are there are groups of atoms, but macromolecular carbon, I want to focus in on that for a moment."

**(04:37) Ursa:** "The macromolecular carbon refers to a form of carbon, with a very large molecular structure. It's not made up of repeating subunits like polymers, but rather a complex network of carbon atoms bonded together. Think of it like a giant interconnected web of carbon, does that make sense?"

Dr. Alexander's insistence on revisiting and focusing on macromolecular carbon underscores its potential significance in the context of life's origins. Ursa's explanation clarifies its structure as a complex network rather than repeating units, providing a

fundamental understanding of this key component of B-type asteroids.

### **Connections to Terrestrial Carbon Structures: Buckminsterfullerene and Carbon Nanotubes**

The discussion then turned to comparing the macromolecular carbon found in B-type asteroids with known terrestrial carbon structures, specifically Buckminsterfullerene (Buckyballs) and carbon nanotubes.<sup>64</sup> Buckminsterfullerene, or C<sub>60</sub>, is a spherical molecule composed of 60 carbon atoms arranged in a cage-like structure of hexagons and pentagons, resembling a soccer ball.<sup>64</sup> Carbon nanotubes, on the other hand, are cylindrical molecules formed by rolling up sheets of graphene, a single layer of carbon atoms arranged in a hexagonal lattice.<sup>72</sup> These comparisons were initiated by Dr. Alexander:

**(04:53) Hakeem:** "Okay, now, yes, it makes some sense. We're getting closer to to flushing this out now. For some reason, what came to mind were Bucky balls named after uh Buckminster Fuller, what are there any similarities?"

**(05:07) Hakeem:** "Or is anything related that we can extrapolate from the ideas of buggy balls? And uh, these macromolecular carbon"

**(05:19) Ursa:** "That's a great question. Bucky balls, also known as fullereens, are indeed similar to macromolecular carbon. In that they're both made entirely of carbon atoms, however, Bucky balls have a distinct spherical shape."

**(05:43) Hakeem:** "Yes, and macromolecular carbon, something that we synthesize on earth, like, for example, carbon nanotubes, those would also be considered a form of macro molecular carbon, would they not?"

**(06:01) Ursa:** "You're absolutely right. Carbon nanotubes are indeed considered a form of macromolecular carbon. They're cylindrical molecules with unique properties that make them incredibly strong and conductive, did you want to explore the specific properties of carbon nanotubes, or perhaps discuss other forms of macromolecular carbon?"

This exchange highlights Dr. Alexander's ability to draw connections between extraterrestrial findings and well-known terrestrial carbon structures. Ursa confirms these relationships, noting that while both Buckyballs and carbon nanotubes are forms of macromolecular carbon, they possess distinct structures compared to the likely more amorphous macromolecular carbon found in asteroids. These comparisons are valuable for understanding the fundamental ways carbon atoms can bond and

form complex architectures, both on Earth and in space.

The following table summarizes the structural differences and similarities:

**Table 2: Structural Comparison of Macromolecular Carbon, Buckminsterfullerene, and Carbon Nanotubes**

Feature	Macromolecular Carbon (Bennu)	Buckminsterfullerene (C60)	Carbon Nanotubes
<b>Primary Structure</b>	Complex, non-repeating network of carbon atoms	Cage-like structure of 60 carbon atoms in hexagons and pentagons	Cylindrical structure formed by rolled-up graphene sheets
<b>Shape</b>	Irregular, likely amorphous	Spherical (truncated icosahedron)	Cylindrical (single-walled or multi-walled)
<b>Bonding</b>	Primarily sp <sup>2</sup> and sp <sup>3</sup> hybridized carbon atoms	Primarily sp <sup>2</sup> hybridized carbon atoms	Primarily sp <sup>2</sup> hybridized carbon atoms
<b>Size</b>	Very large and variable molecular weight	Molecular weight of approximately 720 g/mol	Nanometer diameters, micrometer lengths
<b>Order/Regularity</b>	Less ordered, more heterogeneous	Highly ordered, specific geometric arrangement	Order depends on chirality and number of walls

Studying these connections between different forms of macromolecular carbon is crucial for advancing our understanding of carbon chemistry in space.<sup>47</sup> The presence of diverse carbon structures on asteroids like Bennu suggests that a rich variety of prebiotic chemical processes were occurring in the early solar system, potentially leading to the formation of molecules that played a vital role in the origin of life.

### **Dr. Alexander and Ursa's Deep Dive: Unpacking the Macromolecular Carbon Mystery**

The dialogue between Dr. Alexander and Ursa provides a valuable deep dive into the

intricacies of macromolecular carbon:

**(03:23) Ursa:** "B-type asteroids contain a variety of carbonaceous materials including organic polymers, which are large molecules made up of repeating subunits and macromolecular carbon, which is a form of carbon with a very large molecular structure."

**(03:39) Hakeem:** "Now first you're going to repeat what those things are like those polymers, which are um and the different types of carbon, uh, compounds, we need to repeat that again, we can't just gloss over this."

**(03:58) Ursa:** "Okay, B-type asteroids contain organic polymers which are large molecules made up of repeating subunits and macromolecular carbon. A form of carbon with a very large molecular structure, but these materials are significant because they're considered the building blocks of life as we know it."

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**(05:31) Ursa:** "While macromolecular carbon can take on various forms, they're both fascinating examples of how carbon can form complex structures. Did you want to explore the different forms of macromolecular carbon?"

**(05:43) Hakeem:** "Yes, and macromolecular carbon, something that we synthesize on

earth, like, for example, carbon nanotubes, those would also be considered a form of macro molecular carbon, would they not?"

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This detailed exchange reveals Dr. Alexander's persistent curiosity and his drive to thoroughly understand the nature of macromolecular carbon. His questions demonstrate an intuitive grasp of chemical concepts, leading him to draw parallels with known terrestrial carbon allotropes like Buckyballs and carbon nanotubes. Ursa's responses provide clear and concise explanations, highlighting the key structural differences while confirming the fundamental similarity – all are composed entirely of carbon atoms. The analogy of a "giant interconnected web" effectively conveys the complex, non-repeating nature of macromolecular carbon found in asteroids. This dialogue exemplifies the power of collaborative exploration in scientific inquiry, where insightful questions lead to informative answers, deepening our understanding of complex topics.

### **Conclusion: Bennu, Google Gemini, and the Future of Astrobiological Research**

The OSIRIS-REx mission to asteroid Bennu has yielded groundbreaking discoveries that significantly advance our understanding of the potential origins of life. The identification of amino acids, nucleobases, water-bearing minerals, and diverse forms of carbonaceous materials, including organic polymers and macromolecular carbon, provides compelling evidence for the hypothesis that asteroids could have delivered the essential building blocks of life to early Earth.<sup>1</sup> Bennu, as a pristine sample of the early solar system, offers a unique window into the prebiotic chemistry that may have occurred in our cosmic neighborhood billions of years ago.<sup>8</sup> The collaborative exploration of these findings between Dr. Hakeem Ali-Bocas Alexander and Google Gemini ("Ursa") showcases the transformative potential of advanced AI in facilitating deep research and disseminating complex scientific information.<sup>1</sup> The detailed dialogue highlights the key discoveries and their implications, making this crucial information accessible to a wider audience.

Looking ahead, the continued analysis of the Bennu sample promises to yield even more insights into the nature and origin of organic molecules in the early solar system. Future sample return missions to other asteroids and celestial bodies will further

expand our knowledge of the distribution of prebiotic materials throughout the cosmos. The ongoing search for life beyond Earth will undoubtedly be informed by the discoveries made on Bennu, strengthening the possibility that the building blocks of life are widespread and that life itself may not be unique to our planet. The success of the OSIRIS-REx mission, coupled with the power of collaborative research leveraging advanced AI tools like Google Gemini, marks an exciting new era in our quest to understand the origins of life and our place in the vast universe.

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