

Bioactive



AccuFuse™ Bioactive  
MOLDABLE Putty

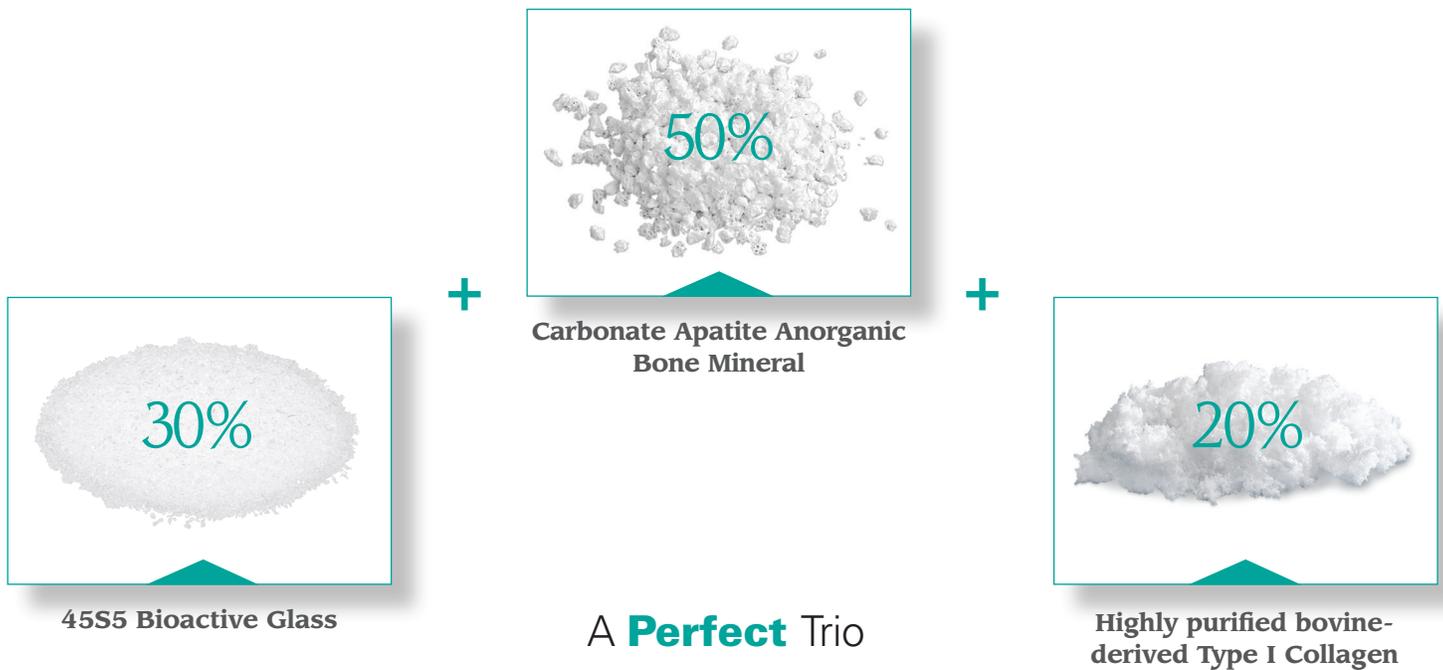
# AccuFuse™ Bioactive **MOLDABLE** Putty

## Our **Bioactive** Solutions

The evolution of our mineral and collagen composite bone grafts has advanced with the development and launch of our unique bioactive glass, mineral, and collagen composite bone graft solutions. We have developed a wide range of mineral and collagen composite bone grafts over the last 12 years with a wide range of adjustable characteristics, and we have expanded even further to offer bioactive moldable bone graft solutions.

## Our **Composition**

Our bioactive composite bone graft matrices are a combination of three components: carbonate apatite anorganic bovine bone mineral, 45S5 bioactive glass, and Type I Collagen. When combined, they provide an optimal scaffold to support the body's natural ability to regenerate new bone.



# AccuFuse™ Bioactive

## MOLDABLE Putty

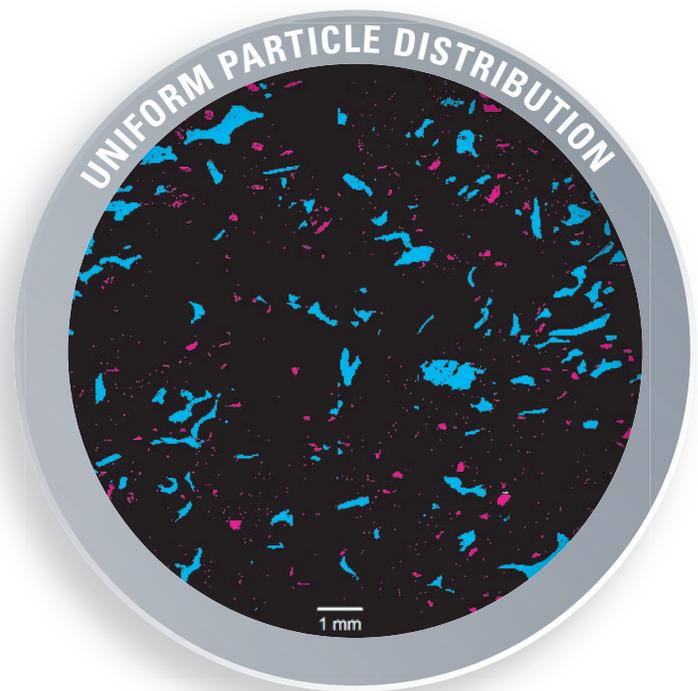
AccFuse Bioactive Moldable Putty is composed of carbonate apatite anorganic bone mineral, bioactive glass, and Type I collagen that can be molded to fit the bone defect. It is an osteoconductive, bioactive, porous implant that allows for bony ingrowth across the graft site. The bone graft matrix is slowly resorbed and replaced by new bone tissue during the natural healing process.

### Why AccuFuse™ Bioactive Moldable Putty?

- ❖ **A Perfect Trio of Components—50%**  
Carbonate Apatite anorganic bone mineral, 30% 45S5 Bioactive Glass, 20% Type I Collagen
- ❖ **Uniform distribution** of bioactive glass and mineral particles throughout the matrix, achieved through our proprietary manufacturing process<sup>1</sup>

### AccuFuse™ Bioactive Glass Component

- ❖ **30% is Optimal:** Less is more. Bioactive glass is incorporated into OssiMend® within a suggested critical range of 5-40% for optimal osteoblast growth and calcium phosphate formation in a composite<sup>2</sup>
- ❖ **Ideal Particle Range:** A narrow particle size distribution limited to 100-300µm to provide a more controlled rate of ion dissolution & surface reactivity, and a more consistent rate of bone bonding & proliferation<sup>3,4</sup>
- ❖ **Exemplary Particle Size (100-300µm):** Larger sized particles may not fully resorb. Smaller particles may resorb away quickly and impede the upregulation of osteoprogenitor cells<sup>4,5</sup>



An SEM/EDX Analysis of AccuFuse™ Bioactive Moldable polished cross sections showing mineral and bioactive glass

- 45S5 Bioactive Glass Particles
- Carbonate Apatite Anorganic Bone Mineral
- Porous Type I



## Moldable Advantage

- ❖ **2 for 1 versatility**—Upon hydration, the strip conformation can be used in its original shape or optionally molded into alternative shapes to address the unique contours of each defect
- ❖ Combined with **either** autogenous bone marrow or autograft with saline
- ❖ Can also be used with autograft as a bone graft extender
- ❖ Puck conformation option is ideal for molding
- ❖ Moldable, flexible, absorbent, resists migration upon irrigation
- ❖ A lengthy 40cc size option unlike any other bioactive moldable bone graft

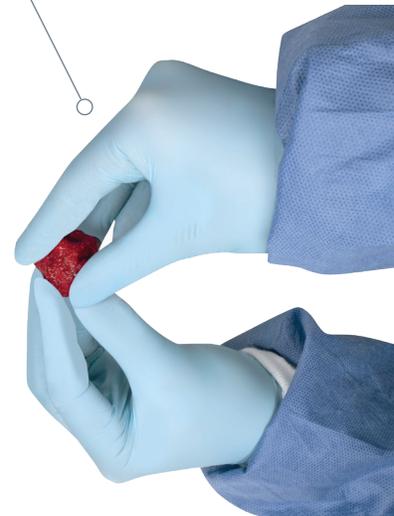
Almost **2x more absorbent** than Vitoss® Bioactive Foam<sup>1</sup> –

- Delivers stem cell rich BMA to fusion site

	ABSORBENCY (ml/g)
AccuFuse™ Bioactive Moldable	4.59 ± 0.76
Vitoss® Bioactive Foam	2.70 ± 0.35



2 for 1  
Versatility



# Why Carbonate Apatite Bone Mineral?

1

Optimal **Resorption & Remodeling**<sup>6,7</sup>

2

**Natural Mineral Structure**

Similar to Human Bone Mineral

3

More **Calcium Phosphate Deposition** than  $\beta$ -TCP<sup>8</sup>

4

Half the crystallinity than HA,  
**More Soluble**<sup>9</sup>

5

Independent Studies have shown  
Higher **Osteoclastic & Osteoblastic**  
Activity than  $\beta$ -TCP & HA<sup>10</sup>



# Why 45S5 Bioactive Glass?

Over **30 Years** of Presence in **Tissue Engineering**<sup>11,12</sup>



- ❖ **Favorable Environment** for bone regeneration and osteoblast attachment<sup>13</sup>
- ❖ **Ion Exchange & Release**—including soluble tetrahedral silica, which may promote rapid bone formation<sup>2</sup>
- ❖ **Cell Proliferation & Differentiation**—45S5 Bioactive glass has the ability to stimulate the growth & osteogenic differentiation of human primary osteoblasts<sup>14</sup>

## Composition of **45S5 Bioactive Glass**

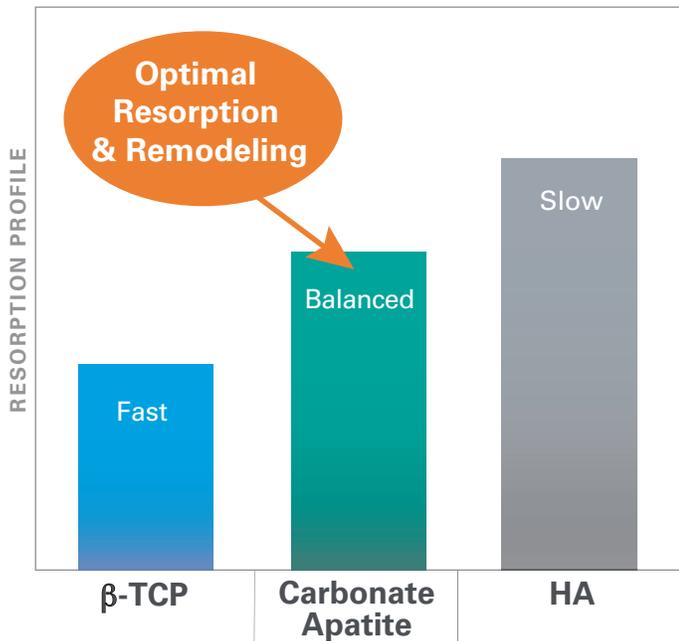
<b>45%</b>	Silicon Dioxide	SiO <sub>2</sub>
<b>24.5%</b>	Calcium Oxide	Ca <sub>2</sub> O
<b>24.5%</b>	Sodium Oxide	Na <sub>2</sub> O
<b>6%</b>	Phosphorus Pentoxide	P <sub>2</sub> O <sub>5</sub>

## Why Type I Collagen?

### **Homologous Molecular Structure** to Human Collagen<sup>15</sup>

- ❖ Highly purified for biocompatibility
- ❖ 100% resorbable through normal metabolic pathways<sup>16</sup>
- ❖ Intrinsic hemostatic properties control minor bleeding<sup>16,17</sup>
- ❖ Well-established long clinical history<sup>16</sup>
- ❖ Binds proteins and cells and retains biological factors<sup>18</sup>
- ❖ Single most abundant protein in the human body<sup>19</sup>

# Five Reasons Why Carbonate Apatite is Superior

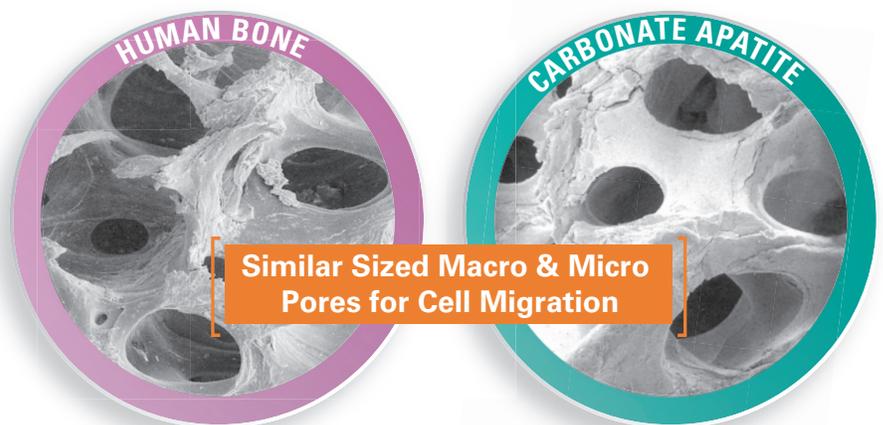


## 1 Optimal **Resorption & Remodeling**<sup>6,7</sup>

- ❖ Not fast like beta-tricalcium phosphate ( $\beta$ -TCP)
- ❖ Not slow like hydroxyapatite (HA)
- ❖ Ideally, the rate of the bone graft resorption is balanced to the rate of bone remodeling
- ❖ Carbonate apatite resorption and remodeling are similar to human bone<sup>6,7</sup>

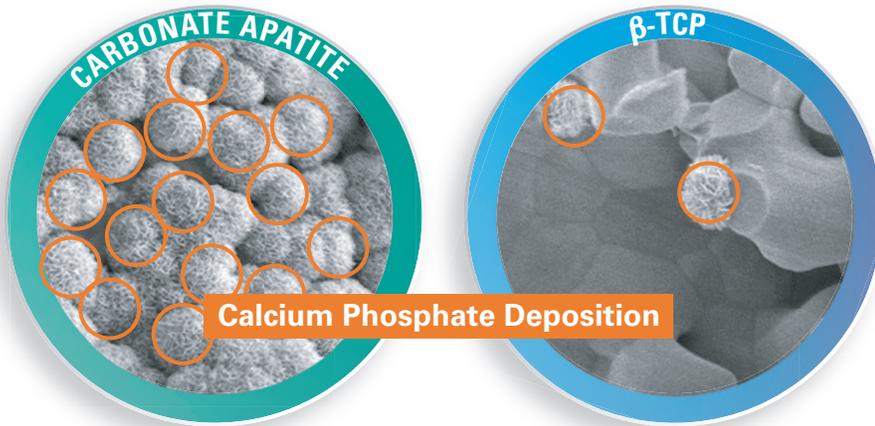
## 2 **Natural Mineral Structure** Similar to Human Bone Mineral

- ❖ Pores provide pathways for cell migration and attachment to lay down new bone
- ❖ Carbonate apatite is a better osteoconductive material than HA<sup>20</sup>



3

### More **Calcium Phosphate Deposition** than $\beta$ -TCP<sup>8</sup>



- ❖ More calcium phosphate is deposited on the carbonate apatite surface as compared to  $\beta$ -TCP<sup>8</sup>

- ❖ Osteoblasts prefer attaching to calcium phosphate to lay down new bone



4

### Half the Crystallinity than HA, **More Soluble**<sup>9</sup>

- ❖ Carbonate apatite has half the crystallinity than HA, which enables optimal resorption and remodeling because it more easily resorbs<sup>9</sup>

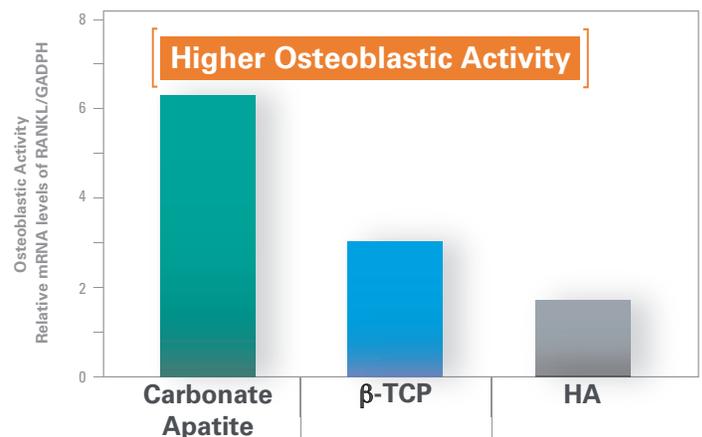
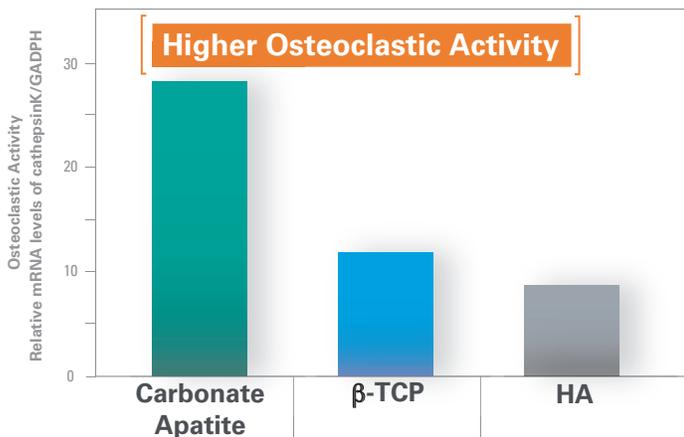


5

### Independent Studies have shown Higher **Osteoclastic & Osteoblastic Activity** than $\beta$ -TCP & HA<sup>10</sup>

- ❖ Osteoclasts break down bone
- ❖ Carbonate apatite shows higher levels of osteoclastic activity than  $\beta$ -TCP & HA<sup>10</sup>

- ❖ Osteoblasts secrete new bone
- ❖ Osteoblast proteins are most upregulated with carbonate apatite than  $\beta$ -TCP & HA<sup>10</sup>



# Ordering Information

## AccuFuse™ Bioactive Moldable Strips

CATALOG NO.	DIMENSIONS			QUANTITY
	Length	Width	Thickness	
MCCBA0503	3.2 cm	2 cm	0.8 cm	5 cc, 1 Strip
MCCBA1006	6.25 cm	2 cm	0.8 cm	10 cc, 1 Strip
MCCBA2012	12.5 cm	2 cm	0.8 cm	20 cc, 1 Strip
MCCBA4025	25 cm	2 cm	0.8 cm	40 cc, 1 Strip



## AccuFuse™ Bioactive Moldable Pucks

CATALOG NO.	QUANTITY
MCCBA025	7 cc, 1 Puck
MCCBA05	14 cc, 1 Puck

## AccuFuse™ Bioactive Moldable:

1. [Data on file at Collagen Matrix, Inc.](#)
2. Gerhardt, L., Boccaccini, A.R. (2010). Bioactive Glass-Ceramic Scaffolds for Bone Tissue Engineering. *Materials*, 3, 3867-3910. Retrieved from <https://doi.org/10.3390/ma3073867>
3. Oonishi, H., Kushitani, S., Yasukawa, E., Iwaki, H., Hench, L.L., Wilson, J., Tsuji, E., Sugihara, T. (1997). Particulate Bioglass Compared With Hydroxyapatite as a Bone Graft Substitute. *Clinical Orthopaedics and Related Research*, 334, 316-325, Lippincott-Raven Publishers, Philadelphia, PA.
4. Schepers, E.J.G., Ducheyne, P. (1997). Bioactive glass particles of narrow size range for the treatment of oral bone defects: a 1-24 month experiment with several materials and particle sizes and size ranges. *Journal of Oral Rehabilitation*, 24, 171-181.
5. Lindfors, N. C., Koski, I., Heikkilä, J. T., Mattila, K. and Aho, A. J. (2010), A prospective randomized 14 year follow up study of bioactive glass and autogenous bone as bone graft substitutes in benign bone tumors. *J. Biomed. Mater. Res.*, 94B, 157-164. doi:10.1002/jbm.b.31636
6. Matsuura, A., Kubo, T., Doi, K., Hayashi, K., Morita, K., Yokota, R., Hayashi, H., Hirata, I., Okazaki, M., Akagawa, Y. (2009). Bone formation ability of carbonate apatite-collagen scaffolds with different carbonate contents. *Dental Materials Journal*, 28(2), 234-242.
7. Ellies, L.G., Carter, J.M., Natiella, J.R., Featherstone, J.D.B., Nelson, D.G.A. (1988). Quantitative analysis of early in vivo tissue response to synthetic apatite implants. *J. of Biomed. Mater. Res.*, 22, 137-148.
8. [In vitro data on file at Collagen Matrix, Inc.](#)
9. Li, S.T., Chen, H.C., Yuen, D., inventors. (2011). United States patent US 8,980,328. Method of Preparing Porous Carbonate Apatite from Natural Bone.
10. Kanayama, K., Sriarj, W., Shimokawa, H., Ohya, K., Doi, Y., Shibutani, T. 2011. Osteoclast and Osteoblast Activities on Carbonate Apatite Plates in Cell Cultures. *J. Biomaterials*, 26, 435-436.
11. Hench, L. L., & Jones, J. R. (2015). Bioactive Glasses: Frontiers and Challenges. *Frontiers in bioengineering and biotechnology*, 3, 194. doi:10.3389/fbioe.2015.00194
12. Hench, L.L. (2013). Chronology of Bioactive Glass Development and Clinical Applications. *New Journal of Glass and Ceramics*, 3(2), 67-73. doi: 10.4236/njgc.2013.32011.
13. Hench, L.L., Polak, J.M., Xynos, I.D., Buttery, L.D.K. (2000). Bioactive Materials to Control Cell Cycle. *Materials Research Innovations*, 3, 313-23. doi: 10.1007/s100190000055
14. Xynos, I.D., Hukkanen, M.V., Batten, J.J., Buttery, L.D.K, Hench, L.L., Polak, J.M. (2000). Bioglass 45S5 stimulates osteoblast turnover and enhances bone formation In vitro: Implications and applications for bone tissue engineering. *Calcif Tissue Int.* 67(4), 321-9.
15. Miller, E.J. (1984). *Chemistry of the Collagens and Their Distribution*. Extracellular Matrix Biochemistry, KA Piez, AH Reddi (eds.). 41-82. Elsevier, New York, NY.
16. Li, S.T. (2000). Biomedical Engineering Handbook, In JD Bronzino (Eds.), *Biologic Biomaterials: Tissue Derived Biomaterials (Collagen)* (1st ed.) 2, 42, 1-23, CRC Press, Boca Raton, FL.
17. Jaffe, R., Deykin, D. (1974). Evidence for a Structural Requirement for the Aggregation of Platelets by Collagen. *The Journal of Clinical Investigation*, 53, 875-883.
18. Geiger, M., Li, R.H., Friess, W. (2003). Collagen sponges for bone regeneration with rhBMP-2. *Science Direct / Elsevier*, 55, 1613-1629. <http://doi.org/10.1016/j.addr.2003.08.010>
19. [Ott S. \(2003, October 21\). Collagen and Bone Matrix. Retrieved from <https://depts.washington.edu/bonebio/ASBMRed/matrix.html>](#)
20. Spence, G., Patel, N., Brooks, R., Rushton, N. (in press). Carbonate substituted hydroxyapatite: Resorption by osteoclasts modifies the osteoblastic response. *Wiley InterScience*. Retrieved from <https://doi.org/10.1002/jbm.a.32083>